E CARE
F TROOPS

OR LINE OFFICERS)

BY

FREDERICK S. MACY
MAJOR M.C., U.S.A.

AUTHORIZED BY THE SURGEON GENERAL

HARVEY MILITARY SERIES

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(For Line Officers)

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U. S. ARMY

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INTRODUCTORY NOTE.

This work is not intended to be a complete exposition of the principles and procedures of military hygiene. The purpose has been to acquaint the line officer only with such facts as will enable him to ensure the effectiveness of his troops, and to equip him, as Regulations require, for the institution of measures to that end which he alone can best carry out. Consequently, all technical discussions and tedious details together with matter that is useful to the professional sanitarian alone, have been omitted; but the endeavor has been, nevertheless, to leave out nothing essential and to explain it in a simple and practical manner. The guides followed have been, in part, the questions most often asked in connection with the subjects presented, as indications of the information of which line officers consider themselves chiefly in need.

To them, therefore, in full appreciation of their hearty cooperation with the sanitary branches, and to physicians from civil life who may find this summary a useful primer, it is respectfully dedicated.

CHAPTER I.

RECRUITS.

The Line Officer as a Sanitarian.—Although it is the medical officer who is particularly charged with the supervision of sanitary matters, Regulations require the line officer to possess as much knowledge of military hygiene as will enable him to care for the troops under his command intelligently and effectively. His responsibility in this respect begins with the arrival of the first recruits and continues throughout the campaign. Indeed, it never ceases as long as he is in the military service of the United States.

Function of the Line Officer.—For an army is extemporized, or created in other ways, out of material freshly recruited from all walks of life. There are boys and fully matured men, taken from the store and the street, the bank and the bench, the factory and the farm, the desk and the ditch, the cottage and the club. They differ in tastes, training, habits, education, religion, occupation, mentality, manner of living, constitution and capacity for work. And it is the duty of the line officer to accustom the individuals of this heterogeneous human assembly to a common environ-

ment, to weld them into a perfect machine and to unify them in physical qualities so that all shall be able to withstand as nearly as possible to the same degree the stress to which all parts of the machine are alike subjected. It is he who trains, develops and moulds the command into a finished whole, who controls its destiny and determines its character as a fighting unit.

Necessity for Physical Perfection.—It is an axiom that the strength of a military organization consists not in the number of men enrolled, but in the number who can bear arms. Physical perfection, therefore, is the prime requisite. Courage is a secondary consideration. The dead can be replaced, but the non-effective in hospital leave gaps in the ranks which can not be filled until their names are stricken from the rolls. They are, consequently, not only a source of expense to the Government, but a source of weakness as well. To those honorably disabled in service belong, of course, all the affectionate ministration and support a grateful people can bestow; but mere weaklings should be eliminated in the beginning.

Defects in Examination of Recruits.—Yet it must not be assumed that the examination made before enlistment guarantees men physically. Circumstances

may be such that accuracy is necessarily sacrificed to speed in selecting them. Or the surgeon may be inexperienced, or otherwise unfamiliar with the requirements of military service, and hence unable to judge well whether an applicant possesses the qualifications essential to a soldier. In other instances he may have been deceived; and in any case a certain number will be accepted either inadvertently or because the "odds are even." The future usefulness of these last, especially, rests heavily upon their commander, for upon his application of the principles governing the care of men depends to a great extent the number who will afterward break down, fall ill, or in some other manner become useless encumbrances. He must know beforehand how to estimate physique, what dangers menace them and how; and he must utilize that knowledge at all times, to the limit of his ability, if he would maintain his command at the maximum of efficiency.

Evidences of Good Constitution.—The possession of a good constitution, that is, of power to resist hardship, fatigue and disease, is indicated by certain physical characteristics. The body is symmetrical and well proportioned; head well shaped. hair thick, eyes bright, face healthy in appearance t not blanched, firm and elastic; lips re ood color and

well preserved, voice strong; chest shapely, well developed and mobile; belly lean, genitalia mature and well formed; limbs muscular, feet and hands strong and of good size. The demeanor should be cheerful, the speech unimpeded and the gait firm and sure. Comparatively few people exhibit all these points, but the more nearly a soldier approaches this type the better able he will be to withstand the rigors of war.

Age.—As a rule men do not attain their maximum growth until they are between twenty-one and thirty years old. Twenty-one, therefore, should be the minimum age prescribed for original entry into military service. Before that time the bony framework is not completed, and the process of developing both tissue and vigor is not finished. Such men are still in the formative period; and mere boys of yet more youthful years, whose energies are directed normally to building up their bodies, can not stand the strain to which their elders, who do not have to divide their physical resources between construction and endurance, can safely be subjected. Under severe training or in campaign they are liable to heart strain, and if that condition supervenes to a marked degree their recovery and future value are problematical; or their vitality becomes exhausted and they fall ill. Some even die of

homesickness. In addition to the hospitals, the guard houses and the haunts of deserters are filled chiefly with boys; for both moral and mental strength are commensurate, to some degree at least, with bodily vigor. The Napoleonic and the Franco-Prussian wars, in which great numbers of boys were sent to the front, have furnished many instructive lessons in these respects. Contrary to popular belief, the American Civil War was fought not by young lads, but by men whose average age was twenty-six. On the other hand, men over thirty-five not infrequently prove unequal to the demands of field service, since waste is then ofttimes more rapid than repair. There are exceptions to all rules; but it may properly be assumed that the youth will succumb while his elder plods sturdily on. For exhausting, desperate or harrassing work, therefore, choose men who are nearer thirty than twenty, but let them not be over forty, at most.

City and Country Recruits.—During the early days of operations men from the cities render better service than those from the country. The former are used to long and irregular hours, loss of sleep, indifferent meals at uncertain intervals, and to ill-ventilated and crowded habitations. They are also accustomed to the nervous wear and tear of competition with others in a strenu-

ous and artificial existence, and have survived most of the common contagious diseases to which they are therefore immune. Their wits are more active, so that they learn quickly, though they are likely to be more or less intractable, and they are adapted more readily to new conditions. But country-bred recruits promptly contract measles, mumps and various other maladies, are more difficult to teach, are not active in mind nor so alert in analyzing and understanding situations, and they do not adapt themselves well at first to the uncertainties of food, rest and shelter to which they are likely to be subjected. Thus the city man, already prepared to a degree for military duty, is built up and improved by the active, out-door life, while the countryman is temporarily disturbed or incapacitated altogether by the unfamiliar conditions that attend it. But the very factors which have operated to the advantage of the city man, with the added influence of past vice, perhaps, cause him to deteriorate sooner than the rustic, who, when he has once become inured, eventually comes into his own and surpasses or survives the other, with a clean, well-ordered, temperate life behind to bear him on. For immediate service, therefore, urban recruits are preferable. For later and long campaign, those from the rural districts are better. And, what

will surprise many, the more thoroughbred either class is,—in other words, the higher in the social scale,—the greater the excellence of their soldierly qualities, endurance, honor and stamina, intelligence and initiative. Blood and breeding are here considered, not wealth merely.

Height.—In estimating the significance of height it is necessary to remember that many of our population come from races which are naturally short in stature. Deficiency according to the racial standard, however, indicates imperfect bone development which is usually accompanied by a corresponding defect in muscular growth and constitutional vigor. Even when this is not the case short men find it difficult to keep up with the column and are prone to become exhausted from the endeavor to do so. They are likely, therefore, to finish a march in poor condition for what else may lie before them. Yet the tallest are seldom the strongest and strength is much more important than stature. Very tall men, especially if they are lanky and long necked, are likewise undesirable. Height depends largely upon the length of the lower limbs, and excess in this respect is evident by comparison with the narrow chest so often found in this type. Such men eat more, relatively, present a bigger target to the enemy, and

frequently are consumptive or inclined to become so. As a rule they soon wear out. The stocky, muscular man of medium height best meets the needs of the army.

Weight.—The weight of a soldier should be chiefly in bone and muscle and bear a definite ratio to his age and height. A certain amount of fat is essential, because it acts as a reserve supply of food and hence of energy, but an excess is simply so much useless burden for him to carry around. While it is better that a recruit should be over rather than under weight, provided that this be due to the solidity and bulk of a powerful frame, yet it must be borne in mind that his heart is little if any larger than that of his slighter companion, though it has much more work to do. It is a matter of common knowledge that the Samson among men often rapidly succumbs to illnesses or hardships that the other readily survives, through the inability of his heart to endure the labor added to that already imposed upon it by the requirements of his great mass at such times. The truly obese man is impossible in military service. But a distinction must be made between obesity and mere increase of fat due to a sedentary occupation, over-eating or lack of exercise. Men of the latter class are often inherently

strong and muscular and lose their surplus under army training. Deficiency in weight, especially when it is marked, usually denotes inferiority and muscular weakness. Though the defect may be due to purely temporary causes, such as insufficient food, over-work, worry, hard study or exposure to a tropical climate, yet it should generally be regarded with suspicion. Some, notably the slender, well-knit, lithe type, are normally light and are proverbially tough and enduring. On the whole, those who are under weight live longer than those who are over weight, and each case must be judged on its merits.

The Chest.—The chest contains the power plant of the human machine. Its dimensions, therefore, are an index of a man's vitality or staying qualities. The lungs and heart, enclosed within it, together constitute the most vital mechanism of the living organism. Upon the perfect functioning of these organs, more than upon any other, depends all that is meant by strength and endurance; for the first take in the oxygen which is to consume the body waste and assist in the preparation of the materials for repair, while the other drives the blood as the common carrier into the remotest parts. But it is not enough that the one should be capacious and the other powerful. They must have

ample room in which to work. So favored, they tend not only to remain healthy themselves, but to maintain a maximum of efficiency throughout the entire system. It is clear that the lungs should receive a liberal supply of air during each inspiration; and it is proper, though not necessarily always correct, to estimate the amount by the expansibility of the chest. It is well to remember, however, that great mobility in a given case may be more apparent than real, as a result of contortion or intentional bulging of large muscles. The chest measure during full, natural inspiration, taken just below the level of the nipples, is normally half the height in inches, or a little more. If the chest be small, defective or otherwise below standard, do not expect it to improve under general military training. Ill-fitting packs or the pressure of straps, even though the weight of the suspended accoutrements is light, retard development or provoke disease in the organs within, in consequence of restricted respiration and embarrassed circulation. Especially is this true of the young and immature, whom youth itself predisposes to deformity or derangement under such conditions.

Correlation of Data.—Finally, consider all these indices of stamina jointly and not singly, with due regard to their correlation and to averge proportions. Height,

weight and chest measure all bear a certain ratio to age. Height more than weight determines lung capacity, yet this is relatively less in tall than in short men, and is seldom great in the obese. The physically sound man who varies least from the general mean and is typically proportioned is best adapted to army service. It is on this basis and in recognition of the necessity for uniformity of men and materials in military affairs that arms and equipment are devised, marches estimated and duties assigned. It follows, therefore, that a man who is markedly either above or below the standard is a detriment and undesirable.

Physical Training.—It will be observed that many recruits are better developed in some parts of their bodies than in others. The ideal system of training, therefore, consists in exercise adapted to the needs of the individual, which are progressive, pleasant and interesting. The recruit whose chest and shoulders are already over-developed is not improved by gymnastics intended for the spindling youth with a two-inch expansion. Neither is a former sewing machine operator advantageously employed in repeatedly going through the leg exercises. The commanding officer should personally supervise these drills, modifying them to meet the requirements of individuals as far as it is possible

for him to do so, in order to accomplish their real object, which is to produce men of equal physical capacity as near the maximum as the time and the material permit. A prime object of all drills is to secure uniformity of action and to inculcate discipline; but physical training, at least in the beginning, best accomplishes these results by attention to the individual as such, rather than by the attempt to make a pretty showing on the parade ground.

Selection of Hours.—It is not unusual to order setting-up and other developmental manuals early in the morning, even before breakfast. This is wrong in principle and tends to break down more than to build up the soldier. Good results are secured, but better men can be turned out in a shorter time if the command be exercised about two hours after a meal. Men can not make muscle and bone after fasting twelve hours any more than an engine can run without fuel. Energy expended under such conditions must be derived from the soldier's own body, and construction of new tissue is impossible, to any degree, when there is in the circulation only a minimum of food material out of which to make it.

Caution to be Observed.—Careful watch must be maintained during the drill to see that no one becomes

unduly fatigued. The heart dilates during severe training, often in an hour or less if the recruit be weak, and the condition merges into a permanent enlargement after many repetitions. This is natural and desirable to a certain extent, but if exercise is too violent or too prolonged before the heart muscle is large enough and strong enough to endure it, damage that can never be repaired is certain to result especially in the young and immature. Pronounced weakness, excessive panting, rapid and weak pulse, blueness or paleness of the skin, faintness and similar signs of physical disorder are all warnings of possible heart strain, and the soldier should be made to lie down and to rest motionless until his pulse is natural again. If this does not occur with an hour, he should be sent to the surgeon. The condition is often the result of hard marching before training is complete. It follows, therefore, that not only calisthenics but practice marches should be light and only moderately wearisome at first, and progress slowly and carefully to the more violent and exhausting kinds, since otherwise a certain number will be lost through disability. In addition to these precautions, no drills, marches nor other duties should be required in the tropics between the hours of eleven in the morning and three in the afternoon, even after the men have become seasoned.

CHAPTER II.

CARE OF THE PERSON.

Air Supply and Ventilation.—Many men are ignorant of the fundamentals of health preservation. This must, therefore, be taught to them, in order that the benefits of training may not be offset by neglect in this respect, nor their efficiency as fighting men impaired. A large number, for example, if left to their own devices, will close all doors and windows, in the notion that colds, sore throats, coughs and similar disorders are caused by cold air. They should be instructed that these troubles arise not from fresh air, which need not be cold, nor otherwise uncomfortable, but chiefly from germs, which are much more plentiful in ill-ventilated rooms than in those which are well aired; while the reduction of oxygen consequent upon restriction of air supply is not only harmful but dangerous.

It is neither pleasant nor desirable to have a part of the body exposed to a draft, but it is not difficult, as a rule, to secure plenty of fresh air without inconvenience. For purposes of ventilation it is sufficient to remember that each man should have not less than sixty square feet of floor space and a minimum of

six hundred cubic feet of air space.

Three thousand cubic feet of air a man per hour should be allowed for respiration, in addition to what may be consumed by fire and light. Hence, if each one has the given minimum of space, the air should be renewed throughout the room five times every hour. An opening of six square inches admits one thousand cubic feet an hour, of air moving at the rate of one foot a second. Air travelling three or more feet per second is perceptible as a draft. A second opening, higher than the first, should be provided for the escape of heated, vitiated air. Chimneys, with or without fire, greatly accelerate the outward flow. It is not always easy, especially in improvised, crowded or underground shelters, to arrange for efficient ventilation; but if the principles are understood a little ingenuity will adapt openings or devise flues that will furnish inlets and outlets of sufficient size and capacity. The problem is relatively simple in summer. During winter weather, when men will stuff the ventilators with rags or other obstructions, on account of cold drafts, means must be added to the system for deflecting the air so as not to blow directly upon the occupants of the room. If there are windows, boards several inches wide and cut to fit the frame, may be placed on edge between

the sills and the lower sashes. The air then enters between the two sashes and is deflected upward. Other openings can be readily fitted with chutes improvised from boxes, to accomplish the same result, or the outer air may be conducted to an opening in the floor, beneath the stove or other heating arrangement.

Sleep and Attendant Conditions.—Hard-working men should sleep eight hours in every twenty-four. They should be trained to get their rest regularly, as well as to exercise regularly, since regularity is almost as great a factor as the time spent, in accomplishing the ends sought. In the field it is not always possible to follow the systematic and ordered routine of barrack life; but if the soldier has been properly schooled in these matters he will be better able to endure irregular and broken sleep when the necessity arises. Whenever it is possible to do so, he should sleep in other clothing than that worn during the day.

Fortunately, the conditions of military discipline are such that the hours and the habits of the command can be controlled by order; subject, of course, to the exigencies of campaign. It is not seldom that men are compelled to sleep on the ground. When this is imperative, rubber blankets, hay, boards, canvas or other dry material should be spread upon the spot

selected. Grass may be pulled and heaped up, but i
less desirable. A flat stone is excellent, since one o
the size required for sleeping purposes retains heat a
long time and is warmer and drier than other sites.
Even in hot climates the earth is likely to become very
damp with dew, and cold from the evaporation of
moisture. Unless the soldier interposes something of
a protective nature between himself and the ground he
is liable to stiffness, rheumatic pains, general chilling.
and an increased susceptibility to colds, pneumonia, and
kindred ailments.

The body covering should be of wool, as water does
not readily evaporate from such fabrics as are even
in part composed of it. Consequently the soldier is
warmer and more comfortable though wet, perhaps,
and less subject to the ill effects of sudden tempera-
ture changes. He should completely envelop himself
in his blanket, not merely spread it over him, and pillow
the head end in any available way so as to obtain better
rest in case of rain. Dry snow makes a warm cover,
and is so porous that respiration is not interfered with,
even when it is a few inches deep over the whole body.

Bathing.—Cold baths are stimulating, hot baths
soothing and restful. Whichever be chosen, the skin is
cleansed of dead scales and freed from poisons, the

pores opened for the release of waste that would otherwise have to be carried off by the kidneys, and the entire system invigorated and refreshed. Health and strength are not possible without bathing as often as is necessary to keep clean. Ordinarily two or three times a week in summer and once a week in winter are enough, but there can be no objection to a daily bath, especially of the feet and genitals.

Soldiers soon acquire the habit of bathing often if they are given the encouragement of appreciation and facilities. From the hygienic point of view a tub bath is an abomination, since one simply bathes in his own filth. Moreover, tubs are not always easy to get nor accessible, and more water and time are needed than for shower baths. These are much to be preferred both on account of economy and availability, since a shower can be readily improvised under almost any circumstances.

A large can, with a few fine holes in the bottom, suitably supported or suspended, furnishes the means of an excellent and refreshing spray with as little as a quart or two of water. If tubs are used they must be thoroughly cleaned out immediately after they have been used so as to prevent possible transmission of disease as well as for aesthetic reasons. Swimming in

clean water is valuable, not only as a means of bathing, but on account of the exercise and play afforded, and should be encouraged. The hands should be well washed before meals, always.

Care of Bedding and Clothing.—Bedding should be aired frequently, once a day if feasible to do so, and all washable articles of bedding and clothing laundered at least weekly. The soldier should have always ready at least one suit of clean underwear and a fresh, soft pair of socks. When practicable he should have a clean uniform also. The fact that the Japanese during their war with Russia made a practice of bathing and of donning a complete change of clothing just before engaging in battle had much to do with their health, the low mortality from infections, and consequently their military strength.

Hair.—The hair should be kept short, not only because this permits the scalp to be more easily cleansed, but for the reason that dirt and germs are thus kept at a minimum. It is so difficult to prevent infestation by lice, under the circumstances attending field service, that every pains must be taken to facilitate extermination of these dangerous creatures, and short hair is a great help in this respect. The beard, if permitted at all, should be closely cropped. At best, it is a dirty

ornament in trenches.

Nails.—The finger nails should be trimmed neatly and accumulations of dirt beneath them promptly removed. It is only a short distance from the tetanus germ of the oft-manured soil of Europe to the grave, if the route be by dirty nails and the itching abrasion of an insect bite, for example. The toe nails should also be given especial attention. These, when ingrowing, are actually incapacitating. To prevent this condition, they should be trimmed squarely across not far back of the ends of the toes. The corners should have only the sharpness clipped off. They should never be cut round nor too close to the bed of the nail.

Teeth.—The soldier should have a tooth brush and be taught how to use it. In our service this is rigidly insisted upon. So frequently do unhealthy conditions arise from unclean mouths and teeth that the thorough cleansing of them, especially upon arising and after meals, is a matter of moment. The high percentage of head and face wounds in the present conflict, compared with previous wars, makes it particularly advisable to keep the risk of infection from these parts as slight as possible. The teeth should be brushed with a sweeping up and down motion and not backward and forward as is so often done. The latter method

accomplishes no more than the unaided tongue and cheeks would do. The object is to clean between the teeth, and what the brush can not remove should be eliminated by some soft pointed implement such as a wooden or quill tooth pick, or by pieces of thread stretched taut by the fingers and worked down with a suitable motion into the crevices.

Inspections.—The command should be inspected at frequent intervals, with feet bare and underwear exposed, to ensure proper cleanliness and the full observance of orders. The presence of vermin and venereal disease should be looked for, and corrective measures applied at once when they are needed. The feet should receive close scrutiny. A good plan is to have the man undergoing inspection stand upon some raised surface, such as the top of a box or the seat of a chair, and to make him jump down, landing upon his toes, when the examination is over. By this means defects in the feet themselves, or in the ankle or cords, can be detected before they are actually causes of disability. Above all else, kindly instruction and supervision in matters of personal physical welfare will seldom fail to find response in the form of clean, fit, habitually careful soldiers. Cleanliness and decency soon become a habit with the trained enlisted man.

CHAPTER III.

MARCHES.

Preparations.—Several factors enter into the conduct of a successful march; the object of which is to arrive at a given point in the shortest possible time, in force and in good condition for labor or battle. Exhausted troops are likely to be already defeated by their own weakness if speed alone is considered. Careful inspection of the command should always be made before the march is commenced, in order that any element of individual or collective deterioration should be removed if possible.

The soldier must always be self-supporting, therefore it is not desirable to leave his pack behind. But it should contain nothing that is not essential, though it should include everything that is. It should be so arranged that straps and belts will not restrict the action of the chest, for this condition is not only a source of weariness in itself by limiting the intake of oxygen which is required for the combustion of the food or "fuel" that furnishes the energy expended, but causes the heart to beat more rapidly and forcibly in order to compensate for the effects of impeded function, and so conduces to exhaustion.

The head covering should be water proof and broad enough to protect the face and neck from the direct rays of the sun. In the tropics or in any other hot climate it is wise to put fresh, damp leaves or a wet handkerchief in the top. This may prevent heat stroke or allied affections. The use of colored linings for excluding ultra-violet rays is advocated by some, but is of doubtful utility. Whatever style of hat, cap or metal helmet is worn, it should be well ventilated. The body clothing should be loose and comfortable, particularly about the hips, neck and chest, so that muscular action may be free. If the chest is bared, so much the better. Wool should be worn, however thin it may be, as there is nothing so chilling and stiffening as cotton or linen when wet, especially during a halt in a breezy location, even in the hottest season. Socks of the same material tend to prevent blistered feet. The old soldiers of the Cuban and Philippine campaigns know well the merits of the woolen shirt and the soft, close fitting sock. The shoes should be accurately fitted, modelled after the naked foot, whole and tight, but not so new as to be stiff and irritating. The men should have a light but substantial meal before setting out; and allowed to drink freely. The canteens should be filled with sterile water, coffee or

tea. Americans prefer coffee to tea, as a rule, but the latter is much to be preferred, and its use should be encouraged.

The Start.—An early start is desirable, but since both men and animals derive the maximum benefit from sleep in the small hours, it is unwise to begin a march much before five or six o'clock in the morning if it is not imperative to do so. The camp or bivouac should be thoroughly policed just before departure. The column should move slowly at first, and halt at the end of half or three-quarters of an hour so that the men may relieve themselves and adjust their loads. Ten or fifteen minutes should be allowed and the march resumed at the end of that period in the manner it is proposed to maintain.

Position in Marching.—As ordinarily executed by the inexperienced, the position of "Attention" is constrained, forced and unnatural. It can not be long endured and is not intended. All that is contemplated is that the head shall be poised naturally and erect, the shoulders squared, the belly wall not protuberant, and the feet so placed as best to support the body steadily. This means that they should diverge at an angle of forty-five degrees, heels together or nearly so. But even this attitude is not adapted to the advantageous

use of muscles brought into play by a man laboring along under a burden. It would be exhausting in such circumstances. The position assumed by the marcher of his own will, doubtless accomplishes the most with the least fatigue. It resembles that of one about to climb a stairway or proceeding against a strong wind. For this reason marches should be conducted in "route order," which is equivalent to letting the men go as they please. From time to time some theoretically ideal attitude or gait has been devised, but none of these has been shown to have any distinct merit. Most of them have had all the disadvantages common to artificial or forced functioning in general and no advantage. Such experiments should be discountenanced.

Length of a Day's March.—Fifteen miles is considered a day's march. Over that, twenty for example, is a forced march. But even longer distances can sometimes be covered without rendering the command utterly unfit, under stress of necessity or the stimulus of victory. Such enterprises usually are a source of loss rather than of gain and are at times actually disastrous. The tendency of young and enthusiastic officers to make record time or distance at the expense of fighting condition should be strenuously opposed. Aside from exhausting the men, it is sure to impair their

morale also, in time. Repeatedly going into acti
out and depressed engenders fear.

Rate of Travel.—The stride of the typical
age man is a little more than three-fourths th
of his leg. From this is derived the basis of
tion, which is one hundred and twenty steps
inches each per minute. This is equivalent
hundred yards in the same time. A brigade, th
will complete a fifteen-mile march in about si
and a division in about eight hours, so that,
for halts, the normal rate of travel is two and
and two miles, respectively.

It is obvious that the difference is due to
that a column moves no faster than its slowest
nent, and that the larger the organization th
the speed, since the sources of delay increase
ber as the column grows. But in all cases
standard be approximately maintained, the
will be reached before the heat of the day is at i
mum, if an early start was made.

However, as a division with its appendage
about fifteen miles of road, the rear guard
reach the point at which the head of the colum
in the beginning, and every delay will incr
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ion the slow ith marching at attention, which is an effective
crease in m f cultivating subconscious control, on which
cases, if l largely depends. Indeed, it has been observ
the objec soldiers of long training have sometimes slept
is at its m freshed themselves thereby while their subcor
ness governed them so that they still marched
lages co miles, in rhythm.
rd can c Every change is a rest, in a sense, so that alte
lumn res of mode is more than simply a change. Parti
ncrease t when passing through a village, marching in
ight hou heightens their pride by making an appeal to the

of military dignity, and adds to their interest in their surroundings; for vanity prompts them to ascertain the impression made upon spectators, and thus distracts immediate attention from their discomforts. Later, the return to route order is a relaxation and another species of rest.

American troops do not march to song, or at least have not been much encouraged to do so in the past. Yet this is another way of varying the monotony, especially if the melodies are inspiriting and are such as the men like. So, too, is marching to instrumental music, of which the bag-pipe furnishes a kind that helps men to lift their feet; and next, perhaps, in inspirational order, is the fife and drum corps. Band music is ennobling more than enlivening, for its art is higher and the appeal it makes is of another kind, and more heroic. The rippling music of the pipes, upon a foundation of drum or droning chord, evokes less response when reproduced in orchestral arrangement, and the noble anthems or the harmonious tunes of folk song have little in them when rendered by the unsupported pipes. When there are several musical organizations in column, therefore, much can be done to utilize the power of music by a careful choice of that sort which will be most likely to yield the emotional effect desired.

Regulation of the Column.—A moving column stirs up clouds of dust which are very trying, especially to those in the rear. It is advisable to divide the men so that some march upon each side of the road while the middle is left clear. This has the further economical advantage of minimizing interference with transport. But what is of very great importance also, the air is better, and it is an undeniable fact that poisoning from impure air can readily occur among a crowd of perspiring, hard working men if they are closely aggregated out of doors just as it can within doors. The additional expedient of moving troops along parallel roads is to be recommended whenever this is practicable, for similar reasons, as well as to shorten the delays incident to long lines of troops. Health, strength, speed and general effectiveness are thus promoted.

It also is advisable to let that section which marched at the rear upon one day, head the column the next, when possible, so that they may recover from the depressing effects of dust, delays and polluted air incident to the former position. The men should be allowed to wear their blouses open, if they prefer, and to proceed as much at ease as possible. But opening the ranks laterally should not be permitted to result in lengthening the column, and distances should there-

fore be carefully preserved. Due allowances must be made, in estimating the condition of the men, for the character of the terrain, as well as for climatic and other features. Roads that are muddy, deep in snow or sand, or badly cut up, naturally tax the strength and patience of the men severely, and are productive of bruises, sprains and other disabilities. No effort, except under emergency, should be made to hurry troops in such conditions. What is gained in speed is more than lost in endurance. Undulating or rolling land is the easiest to march over, and furnishes another instance of the value of variety.

Halts.—In addition to the stop made during the first hour, a halt of not more than ten minutes should be ordered in every hour. Halting places should be flat and dry, shaded from the sun or protected from storm according to the season. The men should fall out, lay their equipment aside and lie down with their extremities outstretched or at least relaxed. A longer rest is likely to render them stiff. These pauses afford opportunity not only for brief recuperation, but for attention to defects in clothing or accoutrement, and for alleviating distress due to sore feet or injury. Canteens may be refilled, socks changed and shoes greased, but unless such things are necessary it is far better to

spend the time in entire inactivity. If the march is a long one, a day of complete rest should be ordered in each week, which amounts to giving the force a fresh start. When progress is difficult and exhausting, owing, for example, to mire, sand, hilly or rough country, snow, or head winds, rests must be given more frequently than once an hour and for longer periods. It is of little use to arrive at a designated point with only part of the command, or with all of it incapacitated. The pace should be slowed also, and a halt ordered as soon as obvious panting and flushed faces give warning of the approach of prostration or heart strain.

When it is not practicable for the men to lie down during these rests, they should form a circle or circles, in which each man sits upon the knee of the man behind him. All composing the circle thus rest in a seated position, sustained by the continuity of the formation. When the march is about two-thirds finished, a halt of one-half hour or longer is made and the men should have a satisfying, but not too liberal a meal. For this purpose cooked food should be carried or rations that can be quickly prepared. Halts should not be made in towns or villages, and supplies needed from them should be obtained by details.

Effects of Delays.—Involuntary delays have a very different effect upon troops from that of intentional halts. The latter are restorative, the former devitalizing. The essentially trying element about them is the uncertainty as to the cause and duration. The command remains in place, waiting, not knowing whether they shall be hindered a few minutes or several hours, and unable, therefore, to divest themselves of their impedimenta or to rest. They fret and are restless. Some wag usually enlivens the situation by appropriate speculations or pointed jests, but even these can not offset the nervous wear and tear upon men who are half smothered in dust, parched with thirst, unprotected from the heat of the sun, or shivering in rain or snow according to the times. It is much harder to stand, under such circumstaces, in heavy marching order, than it is to march. No effort should be spared to relieve them from the irksomeness of the situation and from the necessity for standing under arms. As delays multiply, the effects become more marked, and if they are excessively frequent a certain degree of physical and mental demoralization is bound to occur. It is imperative that the cause and the probable minimum duration of the delay be signalled back so that what would otherwise be an exasperating blockade may converted into a restful halt.

Night Marches.—Except under the most urgent emergency, troops should not be required to march at night. Military necessity is the only excuse, and commanders should be very sure that the occasion fully justifies the order. The loss of sleep with its consequent debility results in much more weakness of military strength, by which is meant efficiency in number and quality of fighting men, than is ordinarily commensurate with the gains to the cause. The physical ill-effects of a night march are not wholly overcome for two or three days after the march has ended.

Tobacco and Alcohol.—It is not uncommon for soldiers to smoke on the march, and since they derive a certain solace from tobacco it is well to permit the practice within limits. But men should be educated to indulge in their pipes or cigarettes only during long halts, as at meals, since smoking adds one more contamination to the already bad air in which the reeking column moves. Moreover, it increases the dryness of the throat and exaggerates the sense of thirst. Many of our men chew instead. This is less objectionable in some ways, but though the mouth may feel moist and more comfortable, especially in a dusty atmosphere, fluid is abstracted from the body when it is most likely to be needed, and a certain amount of weakness ensues as in the case of smoking.

In all cases, there is a greater or less loss of stren in the heart beat though the rate is increased, in wh ever form the weed be used, and this combination events is at best disadvantageous. Alcohol should be tolerated at any time or in any place. It sho not even be used as a stimulant in collapse, if anyth else is available for the purpose, since it is follow by a depression sometimes greater than that for wh it was given. It is equally bad whether it be giv in hot weather or in cold. Aromatic spirits of a monia, which is carried by all men of the Medi Department, is much better and acts more quickly.

Care of the Feet.—Much trouble is encounte from disabled feet. The commonest complaint is bl ters. These are usually attributed to the irritation a shoe. It is well to remember that the sock may to blame instead. If this is of wool, care should taken to see that it is not wrinkled or sandy. If is not woolen, it should be replaced by one that When a red spot appears on the foot, it should be once protected by a piece of plaster. If the blister l formed, this should be punctured by a needle pass once or twice through a flame, the contents pressed o through the hole, which should be at the lowest poi and the skin left intact. The spot should then be co

ıred with adhesive plaster and the original cause re-
noved if possible.

When practicable, it is an excellent practice whether
he feet be sore or not, to wash and dry them well,
ınd then to dust them generously with talcum powder,
hough some prefer soap, as a matter of routine pre-
ention. As the underlying cause of blisters and most
ther abrasions of the feet, when they are not tor-
nented by sand or small pebbles, is some looseness
f the shoe or rubbing of the socks, an excellent way
o prevent these is to apply a small strap or piece of
ope under the sole of the shoe, crossed over the instep
ınd secured around the ankle like a skate strap. If this
s reasonably tight the march can be finished even with
omfort by one who has been limping and nearly ready
o seek the ambulance.

Stragglers and Sick.—Straggling should not be per-
nitted. If a man is able to keep up he must be re-
ıuired to do so. It is hard to keep men cheerful and
ontented when they observe their fellows falling out
n the slightest pretext and riding in the wagons when,
n the opinion of the majority at least, there is no ex-
use for such ease of locomotion. Soldiers are very
ıuman and quickly jump to conclusions. Only after
ıctual and satisfactory demonstration of disability

should a man be allowed to leave his place for a position in which he can comfortably stretch himself out at pleasure and grin at his less fortunate burden-bearing comrades.

Men who are ill, however, should be promptly sent to the rear, as their presence has a depressing effect and often causes kind hearted companions to carry others' equipment and weapons in addition to their own. Further, early recognition and treatment of cases of illness often restores a man to the ranks who would otherwise be incapacitated a long time or lost to the service altogether.

Use of Drinking Water.—An old soldier will often march all day without water and not feel the need of it. An inexperienced man, however, will empty his canteen before the march is fairly under way, especially if the day is hot. Every wayside source of water tempts him thereafter to drink, and, unless strict discipline be maintained in this regard, he will not only yield to it, but will refill his canteen for further use with no thought or knowledge of the nature of the water itself or of the consequences of drinking it. The unregulated drinking of water on the march increases perspiration, upsets digestion and produces weakness. *A water-logged man* is incapable of much work. He

does not become "hard." Recruits learn this sooner or later, but they must be controlled in the meantime.

The quantity of fluid actually required is determined by the loss that occurs. The body gives off water from the kidneys, the skin, as perspiration, and in the form of vapor in the breath. The amounts and the rate depend upon the labor performed, the heat, and the supply, chiefly. Allowances, therefore, must be made for circumstances. The loss of a gallon is likely to be fatal. Three quarts can be lost without actual danger, but with inconvenience and a considerable degree of physical inefficiency. Two quarts are a source of slight inconvenience, but no danger, and with only slight impairment of effectiveness, while the reduction of total fluid by one quart has no perceptible effect.

Under average conditions, a man can march fully half the regulation distance, seven and one-half miles, without taking another drop of water, and in all events he has a margin of safety of one quart, even if he has lost as much as two quarts of fluid, before the danger point is reached. It is indeed seldom that he will be subjected to such extremes, even in hot weather. Consequently it is very seldom that water is needed before the end of the half march, and not more than one quart should then be allowed, taken during a halt.

If the entire distance can be covered without additional fluid, since it is assumed that the command has drunk copiously before the start, so much the better.

Tea assuages thirst much better than water. It should be sweetened, which increases its value for the reason that energy and strength are largely derived from sugar. In hot climates, the juice of the green cocoanut is more valuable than any other fluid. It has the additional merit of being surely free from disease germs.

Thirst.—Thirst is of two kinds. There is that which results from dryness of the mouth and throat, or as a consequence of much and frequent drinking. This is principally a matter of habit, as distinguished from the craving which is the manifestation of actual need. Most thirst is "habit thirst," as far as marching troops are concerned. "Necessity thirst" will seldom demand attention under average conditions, since it would result only from the loss of large amounts of body fluid. It follows that what is considered a craving for water, ordinarily, will be relieved by anything that moistens the mouth and throat. Men should be encouraged to chew gum on the march. This great American habit is here of real benefit. Small pebbles may be placed in the mouth, or any other small, innocuous substance

:se devices excite a free flow of saliva which keeps parts moist, takes up the dust and relieves the feel- of distress that would provoke the men to drinking er, in the absence of other means. Many old sol- s, when they are averse to taking in more fluid but 'er from dust and a sense of dryness, rinse the ıth and throat with a sip of water which they ı expel.

:nding the March.—As the end of the march ap- aches, the pace should be slowed, so that perspira- may be evaporated or at least lessened, and the ı arrive in a fairly dry state, less likely to suffer n chill or muscular stiffness. Immediately upon ing, the command should be thoroughly rested for alf hour, and then allowed their regular meal. It nadvisable to permit them to eat at once, and the ıy that is almost always inevitable in this respect :n camp is made, is really an excellent thing. Later, men should bathe if this is possible, wash their hing, grease their shoes and make all clean and ly for a fresh departure in the morning. Especially ıld they have whole socks, well washed and rubbed . And immediately thereafter, though the sun be up, most of them will be glad to desist from the and the chatter that invariably break out when

they are once more fed and in good spirits, and roll into their blankets for that sleep which only the soldier knows. However, the physical wear and tear of marches is now greatly diminished, owing to the remarkable development of the automobile.

CHAPTER IV.

TRANSMISSIBLE DISEASES.

Causes of Disease.—Although soldiers are liable to any of the afflictions that harrass mankind, they are peculiarly in danger of those which are transmitted from one person to another, owing to the nature of their mode of living in close aggregations under conditions that are not always favorable to the preservation of health. Transmissible diseases are each caused by a living organism. If this belongs to the vegetable kingdom it is known popularly as a germ, and is really a kind of fungus. It is so small as scarcely to be visible even with a powerful microscope. If it belongs to the animal kingdom it is generally designated as an animal parasite, is often as minute as the other kind and in some cases so closely resembles it that scientists are in doubt as to just what it is.

However, the main fact is that all these causative organisms are parasites in the sense that they derive their sustenance, and multiply, at the expense of the body they have infected, and that a certain amount of elementary knowledge of the subject on the part of line officers, together with their hearty cooperation with the medical staff, are necessary to prevent those de-

vastating ravages from disease which, unchecked, are a greater menace to an army than the projectiles of a human enemy.

Modes of Transmission.—Transmission may be direct or indirect. In the first instance the parasite is passed from one person to another without the intervention of a third person or of some other agency. In the second, the parasites from an infected person are carried upon or in some living host, or by food, water, utensils or other means to a second person who thereby becomes another victim. Some diseases are spread only by direct methods, some only indirectly, and yet others in either way. It sometimes happens that an individual will harbor large numbers of a certain parasite without having himself any symptoms of the corresponding disease. Nevertheless he may act as a sort of storehouse from which many others may receive the infection and sicken or die from it. Such a person is technically called a carrier, and is particularly a menace because of the frightful havoc he may unwittingly work and the difficulty attending detection of the fact that he exists, as a carrier, at all.

Measles.—One of the diseases that appear with surprising constancy among new troops is measles. The specific cause is still obscure, but much is known

of it, notwithstanding. It does not live long in the presence of fresh air and sunlight, probably only a few hours, and though it may exceptionally be transmitted indirectly this is not the rule. Usually direct and close association with the sick man himself is necessary, as the causative agent is probably disseminated in the spray and droplets of mucous expelled during coughing and other respiratory efforts.

Measles is not, ordinarily, fatal; yet it occasionally causes a high percentage of deaths when it is epidemic among adults, and at least incapacitates them for several weeks. It is most infectious before the rash appears, which is usually after the soldier has had what resembles a bad cold for some days. Therefore, take note of men who are affected with a severe cough or a marked attack of catarrh, and send them to the surgeon for examination. When they cough or expectorate they should be required to do so into rags or handkerchiefs which should later be burned, boiled or otherwise rendered safe. Other men should not come into close association with them. Disinfection of the squad room or barracks is not required after measles is discovered. Fresh air and sunlight are sufficient in all but the rarest circumstances.

Mumps.—Mumps is another trouble among new troops. It is never fatal, itself, but is just incapacitating enough to cause annoyance and to take the victims out of ranks. It is not as frequent, perhaps, as measles, but it may be at times. It is due to a germ which probably is transmitted, much as measles is, by the secretions of the mouth. Generally the first sign noticed is a swelling at one or both angles of the jaw, and more or less difficulty upon swallowing. Disinfection is not required.

Chicken-pox.—Chicken-pox, though not especially prevalent among troops, not infrequently appears, and always necessitates prompt action to prevent spreading. It is never fatal. The first symptoms may be so mild as not to attract attention, but a rash will always be seen early in the disease. The cause is still unidentified. Suspects should be sent at once to the surgeon, but beyond isolation of such cases, special measures are seldom needed to effect control.

Scarlet Fever.—Scarlet fever is often dangerous to life, and not seldom leaves some permanent affliction such as deafness, weak heart or paralysis in those who recover. It should be strenuously combatted whenever it appears. It is probably caused by a germ and is transmitted both directly and indirectly. Thus the dis-

may be contracted by inhaling the vapor or spray
the respiration of an infected person, or by getting
irus into the mouth through the agency of con-
ıated food, such as milk, or from handling cups,
ıs, utensils in general, or towels, handkerchiefs and
ar articles that have been used by the patient. It
ubtful if the scales that get into the air from the
during the "peeling" stage are at all infectious,
h this was long taught by physicians and is still
red to some extent.

e earliest complaints are general ill feelings, fever,
y a chill, and sore throat. Within a day or two
the onset, which is sudden, a rash will appear,
ly upon the face and neck first. The bedding,
ing, dishes, everything, in short, that the soldier
used or handled, should be left absolutely un-
ıed until the sanitary officer has given directions
erning them. A suspect, in all cases, should be
diately isolated under medical care. Disinfection
e squad rooms or barracks is probably of doubtful
y, but this may be deemed necessary and does no
, in any event. Sunshine, fresh air and a thor-
washing down of the floors, walls and ceilings
probably suffice to prevent those who have not
ly become infected from being stricken.

Diphtheria.—Diphtheria is another very dangerous malady that often besets troops either as individuals or as organizations. Like scarlet fever it is not only likely to be fatal, but incapacitates for a long time and may leave serious consequences in its wake. It is caused by a germ which is generally transmitted through the secretions of the mouth, nose and throat, either directly, as by droplets and spray during speaking, coughing or sneezing; or indirectly through food, fingers, linen and other articles contaminated by the sick man. The first signs noted will be considerable weakness, fever, pallor and sore throat. Just what the illness may be could not be settled by these alone, but they serve to warn the commander that the man needs immediate medical examination. In this disease much evil results from carriers, so that infection is often not destroyed by disinfection. The detection of the source of spread and the manner of preventing an epidemic, therefore, are procedures for the trained sanitarian to direct. The same precautions should be observed in regard to the patient's personal effects as in the case of scarlet fever.

Small-pox.—That scourge of a past era, small-pox, is now quite obsolete so that it merits only passing notice as a terrible affliction due to an animal parasite,

hich will not develop if the entire command be ef-ciently vaccinated, nor spread under these circum-tances should some unprotected individual manifest it. arly signs are a severe chill, intense headache and xcruciating pain in the back. The parasite is trans-itted both directly and indirectly.

Prevention consists in immediate revaccination of he entire command, excepting only those who have reviously had the disease. A source of weakness lies n the fact that inoculations against small-pox will not take" in some persons, no matter how often this is lone. Such people are not immune to the disease, owever, as is popularly believed; but, on the contrary, ccumb as readily as any others.

Tuberculosis.—Consumption, or tuberculosis, is valent among troops just as it is among civilians, the reason that many men who exhibited no signs he disease when they were enlisted may yet have it in an inactive form, which later was provoked levelopment by conditions incident to the service, y have contracted it since admission. It is due erm which is transmitted either directly or in-y, and generally from germs contained in the ration. This may dry, and light particles of it d their way as dust into food, or otherwise

gain access to another human being, carrying with them the still potent causative agents which are fairly resistant and retain their virulence for a long time. The flesh and the milk of tuberculous cattle are also a source of infection.

Close association, with direct transmission of the disease by droplets of sputum sprayed out in the breath, is a common mode of communication. Consequently, the more air space the men have the less danger there will be of any large percentage of cases, especially if men who are below the physical standard are carefully watched. Any who develop a persistent cough with more or less loss of weight should be referred for examination at intervals until no doubt remains concerning them.

Cleanliness, efficient ventilation, dryness and sunlight are excellent preventives. If a case is discovered, thorough disinfection of the man's personal belongings and of the living quarters is always in order. Under no circumstances should he be allowed to remain in barracks.

Dysentery.—Everyone knows that in the past armies have been decimated by dysentery. It is extremely important, therefore, to know something about it and to be conversant with those measures which are

own to be efficacious in preventing it. More de-nds upon the commander than upon the medical offi-r, in this matter, for the former is in constant touch ith the men, and exercises daily and intimate super-sion over the very things most concerned in trans-ission.

There are two classes of true dysentery. One is used by a germ, the other by a minute animal para-te called an amoeba. It is the latter form that causes e chronic type and is most to be dreaded in many spects. Indeed, it is doubtful if a permanent cure the condition is ever more than a rare event. Both ids cause severe cramps, bloody stools and progres-e wasting. In amoebic dysentery the parasites bur-' under the lining membrane of the bowels, pro-: extensive ulcers and may even destroy so much of owel wall that it ruptures and so gives rise to ab-in the abdomen and death. The patient may die many other complications or from sheer weak-Even after apparent recovery he is never so as before because of the damage done to his 're tract.

lier who contracts amoebic dysentery is seldom, of further use to the service, and when there y such victims, the loss in available fighting

men may be so great as to result in total defeat. B varieties of the disease are transmitted in practic the same way. Large numbers of the parasites le the body in the stools, and in no other way. It lows that if every man's intestinal excreta are prop rendered harmless, there will be no dysentery. T requires just as careful attention when all the c mand is in apparent good health, because there chronic carriers of this disease.

If the excreta are simply deposited upon the gro they are soon covered with a swarm of flies wh afterward seek the kitchens and messes, carrying u their feet numbers of the infecting organisms wh they leave upon the food. Or let a privy be so loca or the dejecta so disposed of that parasites are bo directly or in the surface drainage, into a water sup The entire command or even an entire army may menaced as a result.

In some districts truck gardens are fertilized w human manure. This is exceedingly common am farms conducted by Orientals. The consequences eating uncooked vegetables furnished by these est lishments are easily imagined. If the food be hand in addition, by the dirty fingers of a carrier, he beco no better than a scavenging fly. Prevention of

isease is therefore simple, theoretically at least, and onsists in the rigid enforcement of rules which have or their object the destruction of flies and feces, pro- ection and purity of food and water, and cleanliness f hands and utensils.

Cholera.—Asiatic cholera has much in common ith dysentery, from the sanitary point of view, and is aused by a germ which may be found in the dis- harges from the stomach, but leaves the body prin- ipally in the dejecta. In severe cases the discharges rom the bowels may be nothing but water so thick ith cholera germs that it appears milky. The disease ts in suddenly, as a rule, though it may be preceded a diarrhoea, with frightful cramps and profuse acuations. It is fatal in from forty to ninety per t. of the cases. Besides the severe attacks which in a few hours or less, there are mild types which etimes do not even confine the patients to bed. But ho are affected are dangerous to the community, rapidly mortal infections may arise by transmis- from a mild one. As in dysentery, so in this e, also, there are chronic carriers.

precautions to be observed and the methods of ion are the same, since both dysentery and are spread by soil and water pollution and

through the intermediary of flies and of article taminated by the sick man. There is this diffe that bowel discharies alone are dangerous in c tery, whereas in cholera both the intestinal an stomach discharges are infectious.

The cholera germ has a very low vitality outsi the body, so that exposure for twenty minutes t direct rays of the sun is said to destroy it; bu careful sanitarian will not rely on this means a There is evidence that the germ is also destroye weak acids. It is often recommended, therefore, acid beverages be freely used as preventives, and quite possible that if the stomach is perfectly he and contains its natural acid, the germs that ma swallowed will die before they can do harm. Alc and foods that are likely to disturb digestion, sl be strictly avoided during the incidence of chole

Typhoid Fever.—Typhoid is the last of the scourges of armies to be subdued. Even within r years, whole divisions have been ruined by it. this and its close relatives, the paratyphoid fever absolutely preventable. The entire group are ca by germs that closely resemble one another in ways. It is frequently difficult to decide what the c of a sick man's complaint may be, in the early st

and it often happens that a soldier will remain on duty for as long as a week, though ill from one of these fevers, and not think it necessary to seek medical aid until he is so debilitated and helpless that he can no longer perform his labor. During this time he may appear to be declining, and may feel vaguely disturbed, with some rise of temperature which he himself may be unable to appreciate, and there may or may not be diarrhoea. He is often not concerned about his health because he is unaware of any definite cause for anxiety. He thinks he is only "off his feed," and keeps up longer than he should.

The germ is always transmitted by being carried more or less directly from the discharges of a patient to the mouth of another person. Those from the stomach, the bowels and the bladder are all infectious, and the germs retain their vitality for long periods after leaving the body, resisting even freezing. Flies, fingers, food and water do the rest, and the carrier is usually the means of contaminating what flies do not.

There is an average of one carrier to every hundred persons. If he happens to be employed in the mess or bakery, the amount of harm he can accomplish with unclean hands is appalling. The most certain way of preventing the occurrence of these fevers is by inocu-

lation, which is surely effective and usually causes slight discomfort, seldom persisting over twenty-four hours. If the injections be given at about four o'clock in the afternoon, the reactions will be over, in most instances, before the next morning.

Malaria.—Malaria is a very incapacitating disease which appears in various forms, and its first manifestation is usually a very severe chill. It causes fever, great weakness, and destruction of blood. Every malarial rigor is the same, in result, as a hemorrhage. The affection is often fatal. In order that the disease may be communicated, the casual agent, which is a minute animal parasite, must be taken into the body of a certain kind of mosquito from the blood of an infected person, and must then undergo certain stages of development. Afterward, when these are completed, the parasites again enter a human host when the insect bites, emerging from the salivary ducts of the mosquito into the blood of the victim.

From this it is plain that the elimination of malaria is simply a matter of exterminating the mosquito. When this is not practicable both the sick and the well should be obliged to sleep under nets. As the kind of mosquito that carries malaria bites only at night, by preference there is little danger in the day time,

though all persons actually ill of the disease should be screened from the insects at all times. The administration of some form of quinine in small doses is justified as a preventive when more logical sanitary methods can not be followed. Three grains taken thrice each day are sufficient.

Yellow Fever.—Yellow fever is another disease which is transmitted by the mosquito. The specific cause is so minute that it can pass through the finest porcelain filter and is too small to be seen with the microscope. The disease is a very deadly and loathsome one, and has occurred in frightful epidemics. Dengue or break bone fever, and the monstrous condition known as elephantiasis, in which parts of the body, notably the lower extremities, become incredibly enlarged and useless, are similarly transmitted. These diseases, from malaria to elephantiasis, are all communicated in absolutely no other way, in nature, than by the bites of mosquitoes.

Plague.—Bubonic plague is an extremely fatal disorder, manifested in more or less variety, and great epidemics of it are still not far in the past. It is always rife in the Orient, and centers of it are widely distributed throughout the world. It has been so active at times as to ravage the entire globe, and is some-

times designated simply as "pest." It is produced a germ that primarily causes the disease in rats a other rodents. These harbor fleas which feed u them and so acquire the contamination which t probably carry only mechanically. When the infec animal dies the fleas seek a new host; and, if this man, their bites cause the germs to be deposited the abrasions thus made. As all that is required to introduce the disease in man is that the germ shall have access to a break in the skin, it follows that bedding, clothing or any other article that happens to have the germ upon it, derived from the patient, the flea or its rodent host, may be the medium by which this is accomplished. Prevention consists in destroying rats, and rodents in general, protection from flea bites and exemplary cleanliness.

Typhus Fever.—Typhus fever is another epidemic disease which even today is a terrible menace to armies. The specific cause, probably a germ, has not yet been fully identified, but the manner in which it is communicated is well known. Usually the onset is sudden, by chill, fever and great prostration. In the past it has been frightfully prevalent in jails, institutions and camps. It is very fatal. The sole recognized means of transmission is by the bite of the louse. Hence pre-

vention consists in the eradication of vermin, and in the correction of those unclean conditions that foster their propagation.

Hookworm.—Hookworm is a disease that causes a state of chronic weakness and indolence, and has been the instrumentality through which entire peoples and states have been devitalized and their progress retarded. It is so insidious in its course that it is frequently not discovered until the stools have been examined microscopically. The active agent is a tiny worm which hatches in feces, from the egg passed by an infected person or animal. The embryos may then enter the body of a second host upon food or in water, or they may penetrate the skin. Eventually they work their way to the intestines where they reach maturity and reproduce the disease. Prevention consists in the destruction of excreta, the sterilization of water and protection of the feet by sound shoes, together with general cleanliness.

Venereal Diseases.—Venereal diseases are a source of much non-effectiveness among troops. In all but rare instances they are transmitted directly. Eradication of them is peculiarly difficult, owing to the fact that it is impracticable either to destroy the sexual instinct in normal human beings, or to educate them to

such a degree that this most powerful impulse in n will always be held in universal restraint.

The method of dealing with the problem dep upon the attitude of the public and of the governm toward it. In the United States Army, the men taught that continence in the unmarried is not possible, but that it is consistent with good he They are instructed in the consequences to thems and to their posterity of these infections; and an e is made by providing amusements and club featur keep them voluntarily and contentedly within their domains.

At the same time it is recognized that these ef will fail to a high degree. Therefore means are nished so that a man can find ready at any hou the day or night the proper facilities for cleansing self and for applying preventive measures. An tendant is always on duty at the hospital or infir to assist and to instruct in the use of these. prophylactic so rarely fails that unless a soldier develops venereal disease can prove that he us in the prescribed manner, he forfeits his pay du the period of his invalidism, the time lost is add the term of his enlistment, and he is liable to tri addition. These measures have reduced the percen

these diseases from about seventy-five per cent. of sick report to a relatively insignificant figure. To vent concealment of ailments due to misconduct, the ıi-monthly physical inspections are held at unex-ted times, and include an examination to that end.

Ieningitis.—Cerebrospinal fever is a dangerous ady that occasionally visits camps in epidemic form. ɔegins in different ways, but typically with chills, ɜre pains in the head, as well as in the back, stiffness he muscles of the neck, fever, and great sensitive-ɜ to noise and light. It is caused by a germ which ɛlieved to enter the system through the nose and ɔat. Healthy carriers are the chief, but not the sole lium of transmission. Passage of the infection n one to another is probably rather direct, but not ays so. Prevention consists in segregating the sick, iding close association with others, and proper de-ıction or disinfection of everything that may have ome contaminated. The use of antiseptic throat ıys and nasal douches may be of service.

'etanus.—Tetanus or lockjaw is nearly always ıl. It originates from a germ which is abundant horse droppings and in soil fertilized therewith. ny cases have occurred during the present conflict ng to the fact that wounds are often fouled with

earth, either directly from the trenches or through the medium of dirty clothing. Stiffness in the neck muscles, difficulty in mastication or in swallowing, and sometimes chills are generally the first signs and occur two or three weeks after the injury was received. As the germ is not passed from one person to another, but only through contamination of a wound or abrasion, prevention consists in cleanliness, and in the instant application of iodine to all breaks in the skin. The surgeon will administer antitoxin.

Other Infections.—In addition to the disorders already specified there is a considerable number of others less important, also derived to a variable extent from unclean surroundings and from human and animal excreta. They include tapeworm, fevers communicated by ticks, and ptomain poisoning which results from eating decomposed food.

Significance of Epidemics.—Although the diseases which distress mankind are legion, the few enumerated here will suffice to show that those with which armies have principally to contend are all preventable. Absolute freedom from them is seldom attainable, for many reasons; but an epidemic is a reflection upon the medical service and a discredit to the commander whose troops suffer from it. No communicable disease can

gate when it is opposed with energy, intelligence
ıfinite attention to detail.

ırces of Germs.—It will be observed that all in-
ın originates directly or indirectly from another
ĸisting case and that quite the whole process of
ding is accomplished through agencies that are
ɔllable. These are chiefly feces, urine, discharges
ssue from the mouth and nose, and other fluids
e body, as sources; mosquitoes, flies, vermin,
, food, articles of personal use and fingers, as dis-
ors. The most potent enemy of mankind in gen-
ınd of armies in particular is the fly. There is
t no cause of illness and death, from pneumonia
ɔhoid fever, from tuberculosis to dysentery, that
not and does not carry.

ıgers.—Fingers merit consideration in this
ction that the general public does not give them.
are carried incessantly from one object to an-
. Unconsciously they travel to the mouth and
hundreds of times a day, and thence to other
ts. They bring to the lips secretions from others,
any deadly germs these may contain; and then,
ened with the saliva of their possessor, or un-
ɛd at the toilet, they carry his to whatever else
ıext be touched.

There is no end to this interchange of body f
The cook spreads his upon the company food,
waiter his upon the tableware. Thumbs are thrust
cups or the water butt. The finger is moistened
saliva to facilitate turning the leaves of the literat
in the reading room. Pencil points are dampened in the mouth, which is also made a pouch for pins, thread, money or for any other article it can conveniently hold; and these, left upon a desk or table, cast into a locker or given to comrades, are picked up by other fingers which complete the traffic between mouths. By evening everything a man can handle has received a generous portion of human pollution. It is of slight moment that the germs may die. A fresh supply will be busily distributed during the coming day. An epidemic may readily be disseminated throughout a regiment by dirty fingers alone.

Principles of Prevention.—The entire structure of disease prevention rests upon the prompt investigation and, if necessary, isolation of all men who have a cough, fever, a rash, diarrhoea, unnatural discharges or a history of exposure to infection; the penalizing of all breaches of sanitary rules, especially of those relating to the disposition of feces, urine and expectoration; perfect cleanliness of persons, especially of their

hands; destruction of all excreta, garbage and rubbish; the disinfection or burning of all articles that may be infected; purity and cleanliness of food and water; abundant sunlight and fresh air; frequent inspections both of matériel and of personnel, and extermination of flies, mosquitoes and vermin.

CHAPTER V.

MOSQUITOES, FLIES AND VERMI

Development of Mosquitoes.—There are ma varieties of mosquitoes, but not all carry diseas Those that do have very definite characteristics, y it is not necessary that the line officer should be entomologist in order to cooperate intelligently measures to prevent them from harrassing his co mand. He should, however, familiarize himself wi a few details of their habits and life history. T male mosquito is a vegetarian and does not su blood. The female, during the breeding season, fee upon it voraciously, since it is apparently essential the maturity of her eggs. These are deposited in lar numbers upon the surface of water, on which th float either singly or in masses or rafts, according the species. In two or three days they hatch in "wrigglers," which feed upon the organic matter the water.

Some kinds, among them the *anopheles*, which a the malaria carriers, lie horizontally just below t surface. Others wriggle about and maintain a mo or less vertical position. All kinds must come to t surface every few minutes for air, which they obta

ıgh a short, siphon-like tube. In a week, approxi-
ly, the wriggler or *larva,* as it is called, changes
a creature shaped somewhat like a comma. This
ılled a *pupa* and remains at the surface of the
r. It breathes, but it has no mouth and so does
eat. In two or three days the case of the pupa
nt open and the adult mosquito emerges directly
the air.

ine days or more, according to the temperature,
consumed in this process of development. The
er the weather the longer the period. Breeding
es altogether during late autumn and winter, in
ıerate climates, and the insects hibernate then in
rs or other dark, protected places. Eggs will some-
s survive freezing. The duration of life varies,
may be several months.

igration of Mosquitoes.—Mosquitoes do not
el far, seldom a half mile, from where they were
hed. Therefore, if breeding places in the immedi-
vicinity are obliterated, the command will be an-
d only by such of the pests as are brought to it
ı more or less distant sources by the winds, trains,
ons, boats and other transport. These will be rela-
y few because the same vehicles that brought them
also take many of them away.

Breeding Habits.—According to their preferenc in breeding, three classes of mosquitoes may be g eralized. Some, notably the *stegomyia calopus,* or y low fever carrier, the *culex pungens* which transm elephantiasis, and the *culex fatigans* which is concern in the production of dengue, sometimes called bre bone fever, are "house" mosquitoes. They infest h man habitations, by choice, and breed in or very n them. The *anopheles* may do the same, but genera seek breeding places more removed from dwellin The third class, typified by the sylvan or wild mosqui is found chiefly in salt or brackish water, upon marsl generally. The malaria carriers may be associated w these, also, to some extent. The distinctly socia kind choose for breeding places accumulations of wa in neglected buckets, basins, eave troughs, bottl cans, gutters, puddles, flower vases, carafes, cister cesspools, sewers, tubs, drains, in any of the num ous receptacles, in short, found in and near a hou The second class, in addition to these, characterist ally prefer the furrows and depressions of meado cavities in rocks, hollow trees, drainage ditches, p holes and swamps. They breed prolifically in slo flowing streams, close to the banks where the wate shoal and still. The grassy margins of ponds, wh

ae are protected by a maze of reeds and roots, are orite haunts. If the soil be largely clay, wrigglers r be found even in the prints of hoofs. In hot ıates, excellent nurseries are provided by the cup- junctions of the great leaves or fronds of palms, e ferns and other plants, with the stems or roots. : banana, the cocoanut and the palmetto are par- larly offensive in this respect. The sylvan or wild quito breeds only in the salt or brackish water of shes. Occasionally the malaria carrier is encount- l there also.

Resting Places.—Mosquitoes are not fond of ht, sunny spots. They much prefer dark, moist oundings, such as wet grass, shrubbery, dark walls, se cellars, corners of buildings, clothing hung in ets, and the under sides of leaves. Often the se varieties hide behind cushions and curtains, or er furniture. In such places they rest during in- vity. The malaria carriers fly and bite chiefly at ıt. Yellow fever mosquitoes are most active by , though they do not long survive hot, direct sun- t. There is danger from them during the night, ever, if artificial illumination is used, since any l of strong light will stir them into their waking its. The species that transmit dengue and ele- ntiasis fly both by day and by night.

Search for Breeding Places.—The logical way to exterminate mosquitoes is to eliminate their breeding places. In searching for these, casual inspection is not sufficient. The larvae quickly descend into the lower levels of the water whenever they are disturbed, as by the jarring of footsteps, the tipping or rapping of the vessel examined, and the casting of a shadow. Lack of air causes them to rise again in a minute or two, and sufficient time must be allowed, therefore, to ensure that the absence of larvae is real and not merely apparent. Dumping grounds for ashes and rubbish are often thickly infested with the pests, since bottles, tin cans and other containers are usually very numerous.

It is a general practice in hot countries, in order to baffle ants, to set the legs of furniture in shallow tins of water. These answer the purpose excellently, but they are often overlooked as nurseries for mosquitoes. Indeed, it is astonishing how many insects can be hatched in a half pint of water; so that long, painstaking and laborious efforts may be made to exterminate them only to find that some small, obscure and unthought of receptacle is the source of the trouble. Unless this be found, and every nook, corner and hollow explored to discover any others that may ex-

ist, the water in the box of the grindstone, for example, or the water pan in the chicken pen, the mosquito nuisance may be diminished, but it can not be abated.

Destruction of Breeding Places.—As fast as systematic searching brings to light the many devices adapted to the needs of the mosquito, they must be rendered innocuous. Tin cans that are to be preserved as old iron should be burned out and rolled or beaten flat. Any that are discarded must be made incapable of holding water. Bottles should be broken up or stored in such a position that they will drain completely. All tubs should be inverted when they are not in use, the water in fire buckets or in tins under furniture changed at least twice a week, and drip pans beneath ice boxes emptied regularly and frequently. Eave troughs and other drains should be straightened and freed from obstructions. Cesspools and privies should be filled in. Cisterns, tanks, barrels and other reservoirs should be provided with screens as well as tightly fitting covers. Open ends of bamboo should be removed, or drained through a hole at the bottom of the joint. Banana and other water-holding plants should be removed. Holes in trees and concavities in rocks should be filled with earth or concrete, plugged or drained as is expedient. Pools of

standing water, puddles, wagon ruts, post holes, l
prints and hollows of all kinds should be obliter
And in certain regions it is essential to screen
windows, doors, ventilator openings, air chutes
porches, both to secure comfort and to prevent
spread of disease, since utter extermination of
insects may be impracticable for economic reas
Screens should have not less than sixteen meshe
the inch. It is much cheaper and easier to ke
neighborhood free from mosquitoes than it is to el
nate them. When success is once achieved, there
frequent inspections enable the responsible authori
take the "stitch in time."

Treatment of Large Areas.—The eradicatio
mosquitoes on a large scale requires the outlay of
siderable money, the services of a large numbe
laborers and an intimate knowledge of the terrain
cluded within the undertaking. It is properly the p
ince of a trained, sanitary engineer. Authorities
likely to demur at extensive and costly enterp
conducted only for the purpose of killing insects.
it was the total destruction of mosquitoes in the
ama Canal Zone that made the great waterway
sible; and the many millions expended upon the
are not to be counted against either the economic v
of the canal or the innumerable lives that were sa

The same considerations enter into the question of protecting an army, especially in time of war when every man is far more valuable than any treasure disbursed in suppressing disease. Sometimes prisoners are available for the work, which is of advantage to themselves as well as to the community at large. Heavy undergrowth and high grass must be cleared away, since these afford excellent cover for mosquitoes and sometimes conceal collections of water in which they can breed. Lowlands and swamps ought preferably to be filled in, because in this way they are disposed of once for all. A mound or hillside may be excavated to obtain material, but care must be exercised not to create another hollow by so doing. The effects on other localities must be considered, and when the method is inapplicable drainage is efficient as well as cheaper; but supervision must be maintained afterward to prevent the drains themselves from becoming troublesome. Ditches must be cut with straight edges and vertical sides. They must be kept clear of aquatic weeds and grass, have sufficient fall to ensure a free flow and empty in such a manner that no stagnant pool can form at the outlet. Large acreages can be underdrained, sometimes, both economically and effectively.

An excellent solution of the problem in the case of certain lands is to cultivate them. Eucalyptus trees consume so much water that groves of them may accomplish even the reclamation of swamps otherwise difficult to handle. Marshes may be channeled as required and connected with tide water so that they are scoured out daily. The margins of fountains, ponds, pools and streams must be cleared of all grass and other plant life. Ditches that have insufficient fall may be opened into them and the whole system then stocked with fish, which are natural enemies of the mosquito. Minnows, gold fish, sticklebacks and sunfish are excellent varieties for the purpose and devour the larvae voraciously. Tadpoles also feed upon them.

Use of Petroleum.—As an accessory to the measures outlined or in substitution for such of them as may be impracticable, the use of crude petroleum, either alone or in combination, is to be recommended. Light fuel oil is best, and can be used even upon water that is intended for drinking purposes if the supply be drawn from well below the surface. A thin film of floating oil effectually prevents the female from depositing her eggs and shuts off the air supply of larvae so that they quickly die of suffocation. About a half pint is sufficient to cover one hundred

square feet of water. Winds and currents may cause the film to break or to be driven to one side, so that it must be renewed as occasion demands. Any other non-volatile oil will have the same effect, but petroleum is the most readily procurable as well as the least expensive. There are several methods of applying it. Sprays may be used, for instance, or the oil may simply be poured upon the water. The banks of streams, ponds and ditches may be swabbed with mops that have been dipped in it. Probably the best way is to let it drip from a barrel or tank. Numbers of these may be set out along water courses, beginning well up toward their origins, and upon the shores of ponds. Batteries of them so arranged as to oil the surface of a large pond will also send films down the brooks or rivers that rise in it. Consequently, a careful study of the watershed, of areas and of junctions will enable an engineer to protect an entire country side with suitably disposed oil drips, which perform their function day and night, require relatively little attention to keep them in order, minimize labor, material, time and expense, and accomplish more in the same period than hundreds of times the same number of men could do. Water plants must be cleared away, as it has been found that the larvae may get air through the stems.

Elimination in Houses.—To rid a dwelling of mosquitoes, first close and darken all windows except one in each room. Pyrethrum, or insect powder as it is commonly called, in the proportion of two pounds per thousand cubic feet of space, in wide pans each filled to a depth of not more than an inch and a half and set upon bricks, is then to be ignited by setting fire to alcohol poured upon it. Dense fumes are thus generated which stupefy but do not kill the insects. The room is to be kept closed four hours. At the end of that time the mosquitoes will be found upon the window sill and the floor near by, whither they were attracted by the light in an effort to escape. They should be swept up and burned without delay, lest some revive. This method is unattended by any danger to human beings. A slight, brown stain may be apparent upon metals and fabrics, but this is easily removed by wiping or washing. It does no harm. There are other chemicals and compounds that can be used for the same purpose, such as sulphur gas, combinations of camphor and phenol, and gaseous prussic acid. These are too dangerous to be tried except by a skilled officer. Formaldehyde gas is of no use.

Mosquito Poisons.—When oil is not available, strong acids, copper and iron salts, disinfectants

or coal tar may be dissolved in water that is not to be used for drinking purposes. Large amounts are necessary, and the procedure is a dangerous one to adopt in almost every instance. What is known as the Panama larvicide is made by heating carbolic acid to the boiling point of water. Powdered or broken resin is then added in the proportion of one pound to the gallon; and, when this is dissolved, one fifth as much caustic soda is stirred in. The mixture must be kept at 212 degrees Fahrenheit and agitated until a dark, homogeneous emulsion results, with no sediment. One part in 10,000 of water kills the larvae of malaria carriers in a half hour, and one in 5000 is effective in ten minutes or less. It can be used in sprays also, in the ratio of one part to five of water used to dilute it; and if added to petroleum in the same strength, facilitates the spread of the oil.

Breeding of Flies.—Flies breed in horse manure by preference, but if this is not at hand they will utilize the excreta of other animals and of man, and as a last choice, decaying vegetable matter. In extreme cases even damp rags and papers are made to serve. The female is very prolific. She lays between 120 and 150 eggs from eight to twelve times in a single season.

In warm, fermenting manure these hatch in a day even less, into very small, active maggots, of wl there may be nearly half a thousand in a pound refuse. In from four to eight days later the lar become encased and in from three to five days af ward the adult flies burst forth. Allowing ten days development from egg to winged insect, and two we more for the full maturity of the latter, a short calculation will suffice to show that the progeny of a single fly may total almost countless millions in one summer. Indeed, her product in only six weeks would weigh more than 800 pounds on the basis of 1000 flies to the ounce. Fortunately most of them die at the beginning of cold weather, but a few hibernate in favorable places such as cellars, to emerge in the spring, ravenous and prolific as ever. Logically, therefore, the time to begin operations against them is early in the year, in temperate climates; but whatever the month or the place, no effort should be spared to suppress them.

Flies as Carriers.—The young fly is exceedingly hungry when it emerges into the world, and immediately sets out in search of food. It finds the meat component ready prepared and predigested in animal and human excrement. Sugars and starches abound

in the garbage can, the kitchens and the dishes on the table. On all these it gorges itself at its first meal until it has eaten the equivalent of seventy per cent. of its own weight. From then on it spends the rest of its life in much the same way, traveling back and forth from feces to food, seldom going farther than 1,000 yards in a single flight, visiting in turn latrines, stable litter, garbage, messes and pantries, the carcasses of the dead and the lips of the living. Its hairy legs and spongy feet are soon laden with the germs contained in every variety of filth and putrefaction, so that the creature industriously smears the instruments of disease and death wherever it alights. It is only a short way from the lips of the consumptive to the milk upon the table, from the stool of the dysenteric to the salad. The number of germs in a grain of excreta totals millions. The load of misery the fly can carry and distribute is incalculable. As if this were not enough it regurgitates its vile meals from its capacious crop, drawing a milky drop in and out of its proboscis with apparent delight and letting it fall when it is startled into flight. If it is well fed it defecates about once in five minutes. Great epidemics and the devastation of entire armies have been traced to this foe of mankind, and the fact that the

world is still populous is no argument in favor of the fly.

Biting Flies.—It is chiefly the common house fly with which troops have to contend. Other flies are propagated and pass their existence in the same or similar ways. Some species, however, are known to be disseminators of disease in the same sense that mosquitoes are; that is, through their bite. The stable fly, which subsists only upon mamalian blood, is under suspicion in this respect. Sleeping sickness is always transmitted by the tse-tse fly, another biter.

Preliminary Care of Stables and Wastes.—Suppression of the fly nuisance depends upon the proper disposal of all animal and vegetable waste, destruction of the flies themselves, and protection of food. Since they breed principally in the dung of horses and mules, this must receive prime consideration. Stable floors should be cemented or otherwise made watertight, without cracks or holes through which refuse can be swept or washed to the ground below. They must be kept scrupulously clean, especially in the stalls, with broom and hose. Droppings should be swept up frequently during the day and stored in screened bins, covered cans or other fly proof receptacle pending final disposal. If a pit or a vault in the ground is used it

should be lined with concrete, darkened and screened and have no drainage except into a sewer.

It is a matter of general knowledge that a high temperature is generated in decomposing manure. If this is tightly packed the heat will attain such a degree that larvae can not live in it. Since, for that reason, these thrive only in the outer layers, it is well to beat down or to ram the litter hard, both as an added precaution and to economize space. Picket lines must be kept clean in the same way and the ground oiled. Lime is of no use. Advantage should be taken of the facts that flies do not like darkness, to repel them by this means from all places and containers where they are especially undesirable. Kitchens and mess buildings should be constructed with few doors and windows, which should be fly proofed. All waste should be collected into covered cans, and penalties imposed for neglect in keeping these tight. Garbage receptacles should receive special care, and the ground beneath and around them kept clean. They should preferably be mounted upon oiled or whitewashed platforms, raised sufficiently to permit easy access to the soil.

Protection of Food.—Food should be served only when it is required for consumption. It should never be left upon tables; and these, together with the cook-

ing utensils and the dishes, should be cleaned immediately after use and covered or put away as the case may be. Covers of wire gauze, fly proof closets and cupboards, and tight boxes should be provided for food, dishes, towels and all the other paraphernalia of a mess. The kitchen with the least display will have the fewest flies, other things being equal.

Fly Traps.—To destroy flies, traps and poisons yield the best results. A very efficient type of the former is a box-like structure one foot cube or more in size, the frame of which is of wood, the sides, top and bottom of wire netting. One side or the top is removable. The bottom is conical, apex up, with an open point. Fragments of any kind of food may be so placed within for bait as to be inaccessible to insects crawling upon the outside. The bottom must be an inch or more above a table or shelf, on which the device rests by means of prolongations of the corner pieces. It is of some advantage to cover the sides, except for a few inches near the base, with cloth. An excellent application of it is to set it snugly over a hole in the lid of a garbage can. The cover of this is so disposed that flies may enter freely from beneath the flange which yet must come down over the rim far enough to exclude light. Flies enter the

can in swarms, attracted by the contents, and when they have fed instinctively seek exit toward the light through the hole provided. If care has been taken to prevent egress from beneath the trap, this will soon be humming with captives. Other fly-catching inventions are no doubt as good as the box described, provided they recognize the principle that a fly tends to ascend, not to descend, and travels toward light, not from it. When it is desired to empty a trap, the insects may be stupefied by heat and then poured into a fire, or they may be killed by steam, pyrethrum fumes, gasoline vapor, or sulphur gas.

Tanglefoot.—Sticky preparations have a distinct sphere of usefulness and are important adjuncts to other measures. Probably the best is that known as tanglefoot which is made by dissolving 35 parts by weight of resin in 65 parts by weight of castor oil, by means of heat but without boiling. If other oils, such as cotton seed and linseed oils are substituted, the ingredients are heated separately until they boil, are then mixed and boiled again for a few minutes; but the product is inferior. Tanglefoot is applied, warm, with a brush, to sheets of hard, smooth paper which may then be baited with sugar and hung or laid where they will do the most good.

Flies rest upon walls and ceilings by day, but seem to prefer hanging cords and other pendant articles at night. Rather coarse wire may be advantageously strung across kitchens, mess halls, dormitories and in stables, therefore, high up under the ceilings or roofs, and coated with tanglefoot at frequent intervals. Paper pendants similarly prepared may be suspended from chandeliers, brackets and window casings. Latrine shelters are excellent places for a liberal supply of both arrangements; and so, also, are the spaces between the seats, within the pit of a covered latrine trench. Wires can be used repeatedly by burning them clean with a torch and then applying more tanglefoot. Strap iron, such as is used upon some of the boxes containing Q. M. supplies, is as good as wire, if not better in some ways.

Fly Poisons.—There are a few poisons which are very fatal to flies, but inasmuch as they are equally so to man, great care must be exercised in using them. Dishes prepared with them must be plainly indicated or so placed that pet animals and human beings can not reach them by mistake. Arsenical compounds are sometimes dissolved in some attractive liquids such as sweetened water, molasses or milk, and set out in trays or soup plates. A very good poison is marketed in-

corporated in a heavy, porous paper, pieces of which are immersed and left in baited fluid similarly displayed. Formalin, which is a solution of formaldehyde gas in water, may be diluted thirty times or more with one of the liquids suggested and is not only very effective, but has the additional advantage of being relished by the insects. A piece of bread may be placed in any of these solution to act as a resting and feeding platform. Pyrethrum fumes and other poisonous vapors already mentioned may be used if quick action is necessary. The first will kill flies in two or three minutes.

Roaches.—Roaches are often a source of disgust and it is not unlikely that they act as distributors of disease germs, also. They breed most prolifically and infest the cracks of kitchen drawers, the chinks behind sinks, and spaces in walls. They are very timid, and are therefore seen most often at night when the quarters are quiet. They troop forth, then, in a hungry, filthy horde, from drains and other loathsome hiding places, to swarm over food all night or until a strong light or an intruder sends them scurrying away. They are very numerous on ships, where they infest not only the pantries until these seem literally alive, but staterooms and baths also. They may even overrun the

tables during meals. It is sometimes very hard to get rid of them, because they have no peculiar breeding requirements. The eggs hatch into young roaches a few hours after the female drops her well stored egg case, which may be anywhere. Sulphur gas and a few other vapors will kill them, but in order to be constantly free from them some continuously active agent is necessary. Sodium fluoride, powdered and dusted into cracks, insect powder, borax and sugar, all are more or less effective, but the most constantly efficient means is trapping. Tin cans with perfectly vertical sides, or drinking glasses that are similarly straight, are smeared on the inside with a thin grease that will not "creep." Care must be taken that there is no grease upon the outside surfaces or on the rims. Large numbers of these, judiciously distributed, will catch hundreds over night. If bait is used, food refuse or an old, soapy rag will serve. For grease, butter or bacon is excellent. Once inside a vessel so prepared, it is physically impossible for a roach to climb out unless the side is inclined.

Bedbugs.—Bedbugs are such thin, flat creatures that they can conceal themselves in the very finest cracks. They infest furniture, particularly wooden beds, and are found in the seams of mattresses and

pillows only when they have become so numerous as to be crowded in their usual hiding places. They are nocturnal in habit, and can survive without food almost indefinitely. Certain more or less dangerous fevers are transmitted from man to man through their bites. They are decidedly migratory, finding their way into trunks and valises and even from house to house, so that it is not a sign of personal neglect or uncleanliness to be troubled with them. As the eggs hatch into young bugs much resembling the parent, and as all are generally concealed in such fine crevices that it is impracticable to reach them with dusting powders, extermination is not always easy, especially since the eggs are fairly resistant. Gasoline or any other of the petroleum derivatives liberally applied, or forced into cracks, will cause them to swarm out into the open, and either kills them outright or stupefies them so that they can be gathered up and burned. Turpentine, carbon bisulphid and corrosive sublimate are also effective. Steam or boiling water, when these can be applied, destroy both the bugs and their eggs. Fumigation with sulphur gas, prussic acid gas and certain other vapors should be done only by persons familiar with the dangers and the precautions attending their use. It is usually necessary to repeat these processes

in about two weeks, in order to effect complete eradication.

Lice.—It is inevitable that even in barracks some man will be found infested with lice. It is even more certain that in the circumstances attending field service, when the shelters are crowded, clothing constantly soiled and personal contact much closer, a whole command will become verminous. When this state of affairs supervenes, typhus fever, one of the deadliest epidemic diseases known, will sooner or later exact its toll of human life. Once established in an organization lice are difficult to eradicate, and only persistent and continued effort intelligently conducted will succeed. Three kinds are found upon man; head lice, the so-called crab lice and body lice. The first live upon the scalp, the second upon the hairy parts of the trunk and the third in the clothing. The female head louse lays about fifty eggs which are cemented to the hair about a quarter of an inch from the skin. They hatch in about a week. The crab louse resembles the body louse except that it is seldom found in garments.

The body louse is the most dangerous of all and the hardest to exterminate. The female deposits several eggs daily during a period of about six weeks.

are very small pearly or yellowish bodies, glued
e seams, principally, and mature in from seven
ı days. Thus it is evident that a parent insect,
the term of life is about two months, may live
e fully 6000 of her progeny; and that after all
dults are killed the annoyance may recommence
out a week since the eggs will resist most of the
ary insecticides. The creatures suck blood twice
', but can live as long as nine days without food
they are fully developed, which is approximately
'e days after they are hatched. The young can
ndure starvation more than thirty-six hours.
is variety is very ferocious and will attack and
ır any others that may be present. If body lice
liscovered, therefore, it may reasonably be con-
:d that there is no other kind on the man, though
lice may occasionally escape them. When they
eprived of their accustomed sustenance they will
st upon bedbugs, ants, and even upon one another
the fittest survives. They will even disregard
gating gases in persistent attempts to feed, when
are hungry. It is said that they do not attack a
that is wet with perspiration, and this may be
'eason why they seek blood chiefly at night, since
kin is more likely to be dry at that time. Search

for them must be very painstaking. Clothing should be minutely inspected, including the pockets, with especial attention to the seams, the folds, the hat bands and the neck ornaments. Lice are not given to migrating. They stay close to their host and are transmitted chiefly by casual events such as the borrowing, lending and shaking of clothing, and by being left upon toilet seats. When men are closely aggregated, the insects may, of course, pass directly from one to another.

Destruction of Head Lice.—It is not difficult to get rid of head lice. Shaving the scalp is sometimes sufficient. If it is inexpedient to cut the hair, as in the case of women, the adult insects may be removed with a very fine comb, or destroyed by a liberal application of camphorated oil, insect powder, turpentine in oil, spirits of camphor, or vaseline. A ten per cent. solution of acetic acid, such as strong vinegar, will dissolve the cement that binds the eggs, so that a mixture of this with petroleum will free the head of both vermin and nits. The same methods may be used in the case of crab lice. Mercurial ointments are often recommended, but any plain, heavy grease will kill both of these varieties if it is plastered on the affected regions very thickly. All act principally by

suffocating the parasites, and medicated ointments can therefore well be saved for more important purposes. If any nits have escaped destruction, the process will have to be repeated. Shampooing with hot water and cresol soap is also very effective.

Destruction of Body Lice.—These measures alone are not sufficient in the case of body lice, for the reason that the clothing more than the person himself is infested; and chemicals that will destroy vermin are likely to ruin fabrics, so that the problem is somewhat complicated. It is probable, too, that an entire command rather than individuals will have to be treated. Under such circumstances the routine that would be followed with one man must be carried out on a large scale with groups of men. This requires time, facilities and funds, but there is no use in attacking the situation in any other way; for if the members of an organization are cleansed one by one they will certainly be lousy again before the roster is finished.

One or more buildings should be provided, equipped with hot water supply and tubs or capacious vats. The men are stripped and their apparel done up in bundles marked with their names or numbers. They then enter the baths, which are as hot as can be endured, and wash themselves thoroughly with cresol,

benzine, or naptha, soap. Corrosive sublimate or cresol may be added to the water, but a medical officer should regulate this. In the meantime their garments are rendered vermin free, which may be accomplished in several ways. Either moist or dry heat gives good results. It is safer and better for many reasons to suspend them in large iron containers or sterilizers to which live steam is admitted, preferably under pressure. The greater this is the less time is consumed. Thirty or forty minutes' exposure is necessary at 100° Centigrade.

When it is not possible to carry out this part of the program, ironing the seams with a very hot iron is effective, or cresol powder may be dusted into them. A useful preparation is made of two per cent. each of iodoform and cresol, with 96 per cent. of napthalin. It is also said that if the clothing is well sprinkled with 25 per cent. ammonia and put into a tight box both adults and eggs will be destroyed in an hour. At best it is difficult to succeed by any single means. After the baths, the disinfected clothing is returned to the men, who must be kept apart until the whole command, group by group, is deloused. Occasionally an entire division has to be treated, and formal establishments must be erected and equipped for the purpose.

Necessary attendants should wear caps and gowns while they are at work.

The course outlined can not always be followed. In this case the men may be assembled and a handful of powdered napthalin dropped through the collar of each. They must not afterward remove their clothing, even in preparation for sleep, so that the heat of their bodies may vaporize the chemical which will then permeate everything upon them. This procedure is highly extolled, but it must be repeated every four days for twelve days, and supplemented with cresol soap baths on each occasion. The advantages claimed are that the material is very cheap, costing less than two cents a man; there is no interruption of duty, neither plant nor apparatus is needed, and it is harmless to both men and fabrics. Precipitated sulphur is also proposed by some, who affirm that napthalin is irritating. A few spoonsful are to be rubbed well into each article of wearing apparel daily for two weeks. Flowers of sulphur and sulphur soap are valueless. It has been stated that eggs are never attached to silk.

Serbian Barrel.—The Serbian barrel for disinfecting clothing is so simple and efficient that it deserves special mention. It consists of a pit dug in the ground, in which is constructed a dome-like furnace of any

suitable material, with an opening on one side feeding fuel. A flue made of sheet metal leads the opposite side, and the top is left open. A tank, which should be broad rather than high, i in this and supported by braces that rest on the of the furnace. A barrel or drum with perfo bottom or wooden grating is placed over the tank the intervening joint made steam proof by sand A lid, also rendered tight by felt or a gasket, res the rim. Clothing, so disposed in the upper chamb not to interfere with the free entrance of steam erated in the lower, is effectively deloused. E of these devices will care for the garments of a ment in one day. An economical arrangement mount the boilers of several over a trench. The rels are then embedded in clay or dry mud built up a mound around them, so that they are well insu against loss of heat. A fire is built in one en the trench, and a flue erected at the other.

Fleas and Rats.—Bubonic plague is generally demic among rats before an outbreak of it oc among men. The usual agent of transmission, th not necessarily the only one, is the rat flea, w leaves the dead body of its host, bearing with it virulent germs it has imbibed in the blood of

diseased animal. Other rodents, such as the ground squirrel and the marmot, and therefore the fleas they harbor, may also be infected. Just how the insect conveys plague is undetermined, but it is probable that when the victim scratches the irritated spot he rubs the germs, which have been demonstrated in the feces of the flea, into the abrasion. Or it may be that the causative organisms are inoculated directly from the contaminated mouth parts. The eggs of fleas are not attached to the hair of their hosts, so that they readily fall off and hatch in from two to five days, usually, wherever they happen to lie. As all rubbish contains a variable amount of organic matter, the larvae, which are very small, manage to subsist in dust heaps or in detritus in the cracks of floors or woodwork. After about a week more they spin little cocoons from which the young adults emerge in eight days, more or less. Thus they may be troublesome in a house, but can be killed by oiling the floors with kerosene, or by sprinkling flake napthalin about and then closing the rooms tightly for a day. The tincture of green soap is also fatal to them, but alcohol has no effect. A little iodoform or petroleum on the door step will sometimes keep them out.

Destruction of Rodents.—The suppression o plague is resolved chiefly into the extermination o fleas, especially of the rat flea, and this in turn int the destruction of rodents. As the last is practicall impossible, the most that can be expected is to kee their number at a minimum. They are very prolifi and are especially numerous on ships. In fact, it is due to their migrations on vessels, which they enter either voluntarily or by being carried in with the cargo, that plague spreads from one continent to another. They are also found in sewers, which they use not as breeding places but as runways; for they characteristically choose narrow paths such as pipes and the spaces between walls for thoroughfares. The wild species nest in hollow tree branches or in crannies among the roots. Some tunnel into the ground. So marked is this preference for restricted passages that even in houses they seldom run across a room, but appear slow, confused or blind unless they can follow the walls where these join the floor.

It is well to recognize this trait in setting traps or poison, which are the best means of combatting them. Of the former, the cage type is an excellent one, since it admits as many as its cubic space allows. The best device, however, is a garbage can or barrel one-half

or two-thirds filled with water on the surface of which is dumped enough small kitchen waste, such as shredded lettuce, cabbage, bread crusts and similar refuse, to make it appear quite solid. Rats and mice will jump into this without hesitancy, if it is suitably located in reference to runways and approaches. The animals are excellent climbers, but they can not negotiate a smooth, vertical surface. Once in it, therefore, with no secure footing from which to spring, there is no escape, and dozens may be caught in this way by a single can, over night. The arrangement must never be used before dark nor after early dawn on account of flies, neither should there be any light upon it, since rodents prefer darkness for their maraudings. It must be properly policed each day. Occasionally it happens that rats will avoid a well baited trap. They are very cunning as well as curious, and if they perceive the odor of human hands their caution may be stronger than their inquisitiveness. The defect can be remedied by flaming the trap or by wearing gloves. It is sometimes a good plan to arrange a pipe as an approach.

Poisons are dangerous and should be used with the utmost precaution if at all. Probably the best is some preparation of phosphorus in four per cent. strength. Attempts have been made to spread epidemic diseases

among rodents that are fatal to them, but dc affect man. Little or no success has been atta Wild varieties of the animals may be trapped, or ı saturated with carbon bisulphid may be thrust their warrens and the entrances plugged with wet In cities, if plague occurs, rat extermination sl proceed from without the zone of infection in rather than in the opposite direction. All moorec sels, from whatever port and at all times, shou required to keep properly placed rat guards on lines, a close watch should be maintained at the way by day and a strong light directed upon night. Every reasonable effort should be made tc vent bringing rats aboard in the cargo, and to de those already in the ship. Fumigation with su gas will kill rats as well as all insect pests, if properly done. In certain localities where plag likely to occur, it is advisable that houses be c proof construction.

CHAPTER VI.

DISPOSAL OF WASTES AND EXCRETA.

Consideration of Means.—The imperative necessity for destroying all rubbish and filth will not now be doubted. There remain for consideration only the means by which this is accomplished under field conditions when permanent sewerage and the other institutions of municipalities are not available. Such facilities should be installed whenever it is practicable to do so, as in permanent posts or cantonments. In the theatre of operations, military exigency takes precedence over all else; yet even then it is indeed seldom that arrangements can not be made or apparatus improvised for effectively carrying out the principles and the functions of the more elaborate establishments. Much depends on discipline and training. The prompt and complete destruction of all kinds of refuse should become a habit with officers and men, who should be familiar with the simpler expedients which have been devised for the purpose.

Dry Wastes.—A sufficient number of barrels, cans or boxes, plainly marked to show the use to which they are to be put, should be conveniently placed to

receive dry wastes. Covers should be furnis
properly replaced as occasion demands, not
exclude flies but to prevent paper and other li
stances from being blown about. No liquids,
or excreta should be thrown into them. The
be emptied daily and thoroughly cleaned, and
tents should be burned. If, for any reason, i
tion is inexpedient, the refuse may be cast i
and buried. A properly constructed and inte
managed dump should be a combination of bo
methods. The site chosen ought to be a fai
hollow, bounded by a steep rise. The camp
should first bring miscellaneous rubbish, such a
boxes, empty tin cans, bottles and papers. Th
to the bottom or are to be raked down by the
party. Ashes from the kitchens and the inci
are then thrown in so that the entire upper p
consist of perfectly sanitary material while ev
in which flies and mosquitoes can breed is
A fire is to be kept burning along the lower,
margin to destroy all combustible matter. By t
there is no sharp edge of iron or glass on wh
and animals can cut their feet; and useful, new
is progressively built up of homogeneous, unob
able and workable material.

Kitchen Wastes.—Kitchen wastes include both liquid and solid putrescible matter. Separate receptacles, preferably of metal, with covers, should be furnished for each class. Much of the garbage is mixed, and the fluid portion must be removed by straining. For this purpose a detachable sieve of wire or of sacking is fitted into the top of a container for liquids, without obstructing the lid, however, and the slops are poured into it. The residue upon the screen is then consigned to the appropriate receiver and the strainer washed or burned according to circumstances. Much of the solid waste, indeed all of it except under unusual conditions, can be consumed in the kitchen fire during intervals between meals, by the cook's assistants. Both labor and materials can thus be economized. Some kind of incinerator located conveniently near must dispose of any excess. Receptacles should be thoroughly scoured daily with hot soapsuds or with lye, in order to prevent the formation of a layer of foul grease upon the inner surfaces.

Clean Fluids.—When it is not permissible to use a stream and there is no sewer, it is often perplexing to decide what to do with fluids. The question must be settled to some extent, by conditions. The clean drippings at the drinking supply are no menace what-

ever, but a flat stone should be set where it will prevent the drops from wearing a hole in the ground, lest a pool form; and men should not be permitted to brush their teeth, lave their hands and faces or rinse utensils beneath the spigots and thus pollute the soil. If the waste is excessive, it should be caught in suitable vessels. The contents of these as well as other collections of pure water, and even the refuse from hand basins when this is not immoderate in quantity, can safely be disposed of by scattering them well in a sunny spot that is nearly or quite bare, where they will quickly evaporate or sink into the ground. If the locations of laundry benches and baths are changed occasionally, but always to places where there is no shade nor high grass, the waste from these, too, need cause no concern, especially if the earth be porous.

Decomposable Fluids.—Yet it is not well to let decomposable liquids deposit a foul scum anywhere, which flies will surely find, nor accumulate in trenches and puddles for the benefit of mosquitoes. The unsightliness and bad odors of these things, moreover, conduce to uncleanliness in other respects; for the soldier readily argues instances into rules and is slow to discriminate. Therefore it is sometimes recommended that pits filled with rocks and covered with

gratings be built under showers, and that kitchen slop and other sullage be poured into similar contrivances or conducted to them in shallow gutters filled with smaller stones. But all of these are open to the same objections as the bare ground. The walls become clogged with fine filth and crusted with oily, offensive slime, which can be removed only by taking out the equally vile filling of the pits or conduits and freshening the sides and bottoms. Indeed, scattering the liquid in the sunlight is better in some ways than allowing it to putrefy in darkness; for in the first instance it is soon dried, the activities of germs are checked or altogether destroyed, and the soil is more easily scraped if this becomes necessary. However, the expedients suggested are useful, especially in porous earth, if they are well policed at the earliest sign of fault.

An excellent modification of the rock-filled seepage pit, which may be a cubic yard or more in size, consists in setting a bottomless gasoline drum or galvanized iron can in the upper layers of stones, covering these with matting or sacking, and then with gravel and sand or earth successively so that nothing appears above the surface but a foot or so of the cylinder. A sieve or perforated bucket is arranged to fit into the top of this and slops are thereby screened as they are

poured in. A pit fashioned thus near the kitchen will remove the solids from mixed garbage and dispose of the fluid at the same time, so that the number of containers needed is materially reduced. Straw packed into the strainer will sift out the very fine particles which would, in time, clog the pit. The screen should be dumped over a fire and the material renewed frequently.

There is no theoretical reason why trenches and conduits should not be deepened so as to be similarly constructed and thus converted into underdrains, especially if the nature of the soil and the slope are such as to facilitate filtration and ventilation. The merits of an entirely covered system are apparent. Another very efficient device which is used in the same way as the seepage pit, is a deep hole bored with a post-hole auger and provided with a screen, such as a bucket with a wire bottom, jammed into the opening. One of these is sufficient for a company, even when the soil contains considerable clay. Pits and ditches of all kinds, however, should be positively forbidden except when it is impracticable to use incinerators.

Destruction of Manure.—It is sometimes desired to preserve stable refuse for agricultural purposes. This can not be permitted in war time. The only

proper way to dispose of it is to burn it either in incinerators or in the open. The manure may be heaped in windrows, for example, which are then to be set on fire along their whole length. Oil is not necessary. As these will smolder for several days, a certain number of flies may hatch, so that the method is not entirely satisfactory. Burning it in stacks is also allowable and requires less space, but is slower; and unless the whole surface is ignited fly breeding will progress to a still greater degree. The admixture of bedding facilitates the process considerably. So, also, does previous dessication, which is to be recommended whenever it is feasible.

A drying platform may be constructed of chopped straw and clay or sand, afterward dried and baked hard, or of concrete. It should be several inches thick, with three sides each about half a foot high, and inclined slightly toward the open side for drainage. An area twenty feet square for every 100 horses is sufficient for the twenty-four hours' excreta, which should be frequently raked and turned over. In hot climates manure may be disposed of by simply spreading it thinly and evenly upon the ground and breaking it into small pieces by suitable implements. It will dry quickly and be no longer favorable to insect life; but

in places where it rains often, and on damp lands, the method is inapplicable, and indeed is not to be commended in any case. There are occasions when cremation is not practicable for military reasons. The accumulations from the stables may then be closely packed, beaten or rammed into hard stacks for the time being. The interior of these will become so hot as to kill all larvae except those in the outer layers, which should therefore be spaded over and turned in every few days. Or the heap, and the ground surrounding it for a distance of about three feet outward, may be completely covered with sacking dipped in petroleum and held in place by stones or other weights.

Burial of excreta is likely to be ineffective unless similar precautions are taken. A flat-bottomed excavation is first prepared four or five inches deep and a few feet wider on all sides than the contemplated pit. A gutter half a foot deep is spaded out of the entire periphery, and a hole of the required size dug in the center. The dung is then cast into this, pressed down and leveled with the floor of the broad, shallow trench. A layer of plain matting, burlap or canvas is next laid over all and turned down into the limiting gutter, after which the earth is filled in. Buried larvae will work up from a considerable depth, and young adult

flies can escape through several inches of loose soil or even through six feet of sand; but they can not penetrate the interposed screening, and soon die beneath it. The site should be conspicuously marked by a sign showing it to be foul ground.

Latrines.—There are numerous devices for the disposal of human offal, in the field, and choice depends more upon the indication to be met than upon any inherent superiority of one over another; except that in this case, as in all others, preference is given to incinerators. In temporary occupations the pit or deep trench latrine is very generally used. This may be of any convenient size, with straight, vertical or slightly sloping sides, revetted if necessary with sandbags. Sacking should not only be spread out well into the adjacent ground, but should also project several inches into the cavity of the latrine, in order to intercept flies that may hatch in the soil. A pole may be supported longitudinally to serve as a seat, and another arranged as a back rest.

But the best way, since the exposed design is exceedingly objectionable, is to construct a box that completely covers the opening, so flanged at the bottom as to be fly proof, with tight joints throughout. Eight holes per company should be cut in the top, each pro-

vided with a lid hinged with leather, if
better. Some means should be erected,
for preventing the covers from swinging
in order that they shall close automatica
have been raised and released. Within th
of sheet metal, which may be cut fro
should project downward from the top ju
of the holes, to deflect urine away from the
and the ground on which this rests. Pap
be furnished in containers since otherwise
blown about the camp. Separate urinals are
sity and may be easily fashioned from sheet
funnels or tubes set at a suitable angle and d
into the trench. Troughs are permissible but sc
come foul and require frequent scouring and
A seepage pit may be used, also, with sufficiently
flaring pipes, emerging one from each corner,
veniently inclined to prevent soil pollution. Th
should be whitewashed to make them conspicuous, a
plugged with straw, on which a little cresol may
dropped, to exclude flies and to catch the small
of trash that will inevitably be thrown into them.

Some sort of shelter, or at the very least a scre
ought to be erected for the latrine, made as dark
possible and equipped with fly catching devices.

for the trench itself, the least that can be said about it is that it is disgusting and offensive. To keep it as decently as possible it is sometimes recommended that it be burned out daily with straw and crude oil; but this has comparatively little influence upon fly breeding and causes the pit to be filled much sooner. A better way is to spray the interior with one pound of bone black in three gallons of petroleum. The effect, theoretically at least, is to discourage the entrance of insects and to destroy their larvae. It is a method, moreover, that is applicable under all circumstances, whether the walls be shored up with boards or the pit flooded with rain or surface water. Lime is useless, as will be demonstrated by the appearance of white-legged flies on the mess tables.

Whatever expedient is tried, someone should be in charge at all times to see that men do not stand upon the seats, that they use the appliances properly, scatter no litter and cover their excrement with earth. Facilities for washing and drying their hands are much to be desired in these places, but in lieu of them a simple sign, "Wash your hands!" displayed just inside the exit, may inject the idea of cleanliness into their minds sufficiently often to produce good results. When the pit is filled to within not less than a foot of the top

it must be closed with earth, well trodden down and plainly marked.

On the March.—Consideration for the thousands of others who may follow upon a given line of *march*, as well as the effects of soil pollution by a vast horde upon themselves and others, render it imperative that every man who leaves the column to ease himself should dig a hole in which he shall bury his feces. The commands of Moses upon this subject are just as pertinent today as when he led the Israelites. (Deuteronomy xxiii, 12 and 13.) A spot in the open should be selected and not in the brush. In bivouac it is not practicable to establish formal latrines, as a rule, but a straddle trench which is simply a furrow ploughed or spaded in the ground is a very efficient and quickly prepared solution of the difficulty. The men are to use this, squatting astride it and not on one side of it, instead of wandering at will; and each fills his part of it with earth taken from that which was removed, well up over the general level. Although as many of these ditches may be opened as are needed, they are not economical of space and are not adapted to the needs of more permanent camps. They should be plainly indicated as soon as they are filled, as a guide to commands in the rear.

In the Trenches.—Personal ingenuity may be greatly taxed to devise means to be used on the first line. It will sometimes be possible to construct latrines where there is shelter from rifle fire, to which the men can repair through communication trenches. If high ground is occupied it may be feasible to use the deep pit system without danger of flooding. But in many, if not in most, instances a sufficient number of portable arrangements will have to be furnished. The essentials are a metal container provided with handles, as side bars, for clean carriage; and a removable, closely adapted, fly proof seat with cover, on which men can sit or squat. No woodwork whatever, such as flanges, should project into the receiver or fit inside the edges. There must be no obstruction to dumping and thoroughly cleaning it, and no accessory parts so secured or placed as to be soiled by urine or feces. The imagination of a handy artisan will rapidly design all sorts of simple devices that fulfil these requirements, and plans will readily suggest themselves to him for utilizing oil cans, iron tubs, pails and similar articles either by sliding them into box seats or by adapting tops to them with or without supports. Details leaving the trenches are to carry the vessels with them to be emptied into crematories or vaults in

particles and droplets from the mout
fore should be shielded behind a han
least, let men turn their heads away fro
on such occasions, in courtesy if not in

Manufactured Incinerators.—One incin
good as another if it accomplishes its obj
and economically with a minimum of lab
nuisance. The selection of it is to be determin
by its applicability to existing conditions. Th
cumbrous, more or less immobile types, the
which have to be replaced at intervals by th
facturers, are clearly unsuited to the requirem
troops on active field duty. But in permane
semi-permanent camps they are invaluable.

The general construction of an excellent p
comprises a rectangular foundation of stone or
which is set in a pit and opens at one end in
fire box. On this base is mounted a sheet iron,
like compartment in which cast iron pans ar
ported to receive feces and urine. The top, wh
of wood, is equipped with holes; and over the
lids that close by gravity or spring hinges. A se
urinal with a cover and a wire strainer evacuat
the pans. Two of these units are housed in a
shelter and communicate with a single stack of

pipe. While one is being used the other is being burned out. For this purpose the wooden top is taken off and iron plates that normally swing back against the sides of the interior are drawn up in its place. In addition to the principal fire a small grate of coke ignites within the base of the chimney and utterly consumes all noxious gases, so that the device is odorless.

Drier and Incinerator.—A less complicated arrangement for general use consists of a square, brick stove of a convenient height, provided near the bottom with a grating of iron bars. Above and below these are openings for throwing in fuel and raking out ashes, respectively. In the top is fitted a large, deep iron pan for the evaporation of liquids, and in front of this is another hole for admitting solids. These fall a few inches to an iron plate slightly inclined from before backward. The refuse dries and then slides into the fire where it is quickly consumed. A flue rises from the rear, just behind the tank. The device is suitable for use in the field and may even be extemporized.

Portable Incinerator.—Yet a simpler, as well as portable, apparatus is a piece of corrugated iron roofing, for example, in which two-inch triangular tongues

have been cut and turned upward, spaced in rows half a foot apart. Over this is set, like a tent, two more sheets of iron hinged together with wire. One end of this combination rests upon the ground. The other is elevated to make an angle of 35 or 40 degrees. A fire is built at the bottom and refuse is fed in at the top. Ashes sift out through the holes; and the waste, first dried and partly disintegrated by the ascending heat, slides down to the flame. Rapping the furnace facilitates the process like shaking a grate. To prevent the collapse of the sides it is a simple matter to wire these to the edges of the bottom piece, or to turn flanges on the latter. In any event, the chamber can be quickly and easily laid or folded flat for transport, together with its support which need be only iron rods thrust into the ground. If the wind veers, the position of the incinerator can be as readily shifted to accommodate it so that a draft is always assured. Four of these will dispose of all the waste of a regiment except the excreta.

Cylindrical Furnace.—When brick and stone are not at hand, a vertical, tubular furnace may be built of sods laid in courses, with an opening at the bottom below a grid of iron bars, for raking out ashes. It should be wrapped with wire and sustained by posts *driven into the* ground.

Kitchen Incinerator.—A very good arrangement for kitchens is a pit somewhat wider and longer than the field range, filled with stones to a height a few inches above the ground level. A pipe or funnel may be included to conduct liquids into the interior. Upon the top is set the stove, beneath which a fire not only consumes solids consigned to it, but heats the rocks sufficiently to evaporate large quantities of fluids. Such of these as are not thus destroyed percolate into the soil.

Circular Pit.—Another very useful type is a circular pit, lined throughout with rock, in the center of which is built a cone of the same material that rises well above the general level to determine the draft. This device will conveniently dispose of both liquids and solids, with very little fuel.

Materials and Precautions.—There are many other simple and efficient crematories, such as a furnace scooped out of a mound of clay, and a flat pavement of stone rimmed with rubble and banked with earth. Iron rails and pipes may be utilized for grates and supports; tile and stove pipe, empty oil drums and condemned waste cans, a channel dug in a steep hillside and even heaps of stone may be converted into flues. But however an open incinerator is made

it is liable to the objections that it is more wasteful of fuel, offensive, and uncertain in according to the weather. Wind scatters ligh from it and rain quenches the fire. It must b conscientiously, and all earth used to reinforce be cleared away every few days to prevent fli breeding in filth that may have permeated t and escaped the heat.

CHAPTER VII.

SUPPLY AND PURIFICATION OF WATER.

Quantity Required.—The amount of water required by a man daily depends to some extent upon how and where he is living. In barracks, from twenty to fifty gallons are allowed, including provision for bathing, laundry, kitchens, policing, flushing toilets and sprinkling lawns. In camps, three to five gallons suffice, according to whether or not he washes his clothing. In bivouac and on the march he needs one gallon for drinking and cooking. Drinking water alone is estimated at three pints. Horses drink ten gallons and mules six.

Sources.—Sources may be classified as superficial and deep. The first comprise all found above the impervious rock that lies at a variable depth in the soil; such as rain water, snow, streams, lakes, ponds and ordinary ground water. The second is the layer under this stratum which may approach the surface in some places and lie hundreds of feet below it in others. This accumulation, too, is derived originally

from the surface, but now and then the rock is fissured or its strata broken and turned upward so that water passes through and collects in subterranean channels beneath.

Springs.—Springs are eruptions of water through the earth. They may arise from near or distant reservoirs, from surface or deep supplies. Thus, in a hollow, the ordinary soil moisture which tends to travel both downward and laterally from a combination of inclined rock formation and gravity, may maintain a more or less constant flow toward the bottom, within the surrounding slopes, until the pressure of its higher levels causes it to break through a weak spot or to emerge through crannies in rocks. The flow of these surface springs is variable, likely to be abundant in wet weather and absent altogether in midsummer. Also the deep layer of water below the bed rock, pressed downward from remote mountains, for example, may be forced upward in similar ways, to bubble forth as a characteristically clear, sparkling, cold and never failing fountain.

Surface Water.—All surface water is contaminated with vegetable and mineral matter, human and animal refuse, germs and all else that may be washed by it out of the ground. The degree of pollution de-

nds partly upon the proximity of dwellings, farms, ties and other communities, and partly upon the num- r or dilution of the offensive substances. Thus a ook or a small pond may be converted into nothing ss than a sewer or a cesspool by the offal of a llage. A great river may receive the excreta of a ry large municipality and yet be defiled relatively uch less. Therefore, insignificant streams and pools e likely to be the most deadly. But it is an inflexible le to consider all surface water dangerous to troops gardless of the possible extent of contamination.

Water courses are simply natural drains, and con- niently carry away whatever is cast into them, so at it is a strong temptation to dispose of filth by tting it float upon their currents without thought of e possible consequences to those who may drink of em farther down. Troops are under the double bligation not only to guard against any menace to emselves in this respect, but to avoid locating latrines d disposing of waste in such a way as to convey sease to their comrades elsewhere, to civilian aggre- tions, and to their enemies, through the medium of inking water. This, indeed, is one of the greatest all crimes. However, there are regions where rivers, nds and lakes are so commonly utilized for the dis-

charge of sewers, and drain such thickly populated districts, that the danger from them is known to all concerned and even, by repute, to strangers. Under such circumstances it is permissible for troops to take advantage of legalized and designated channels, but only when the propriety of so doing is authoritatively announced.

Relative Purity.—Rain, before it reaches the earth, is the purest of all water in nature; but as it descends it collects particles of soot, dust, and germs, from the lower atmosphere, or washes them from roofs and trees so that it soon becomes like all other surface water. Rivers may be very pure or exceedingly impure according to circumstances, and the quality of any one will vary in different parts of its course. To a certain extent all streams purify themselves. A tributary that is cleaner, or of different composition or temperature, increases the dilution. Silt gradually settles to the bottom as it is carried along, and drags down with it germs and other minute organic impurities that are attached to it. Sunlight exercises a destructive effect on much that is injurious to a depth of several feet. Waterfalls and rapids cause air to be well mixed with the flow, so that there is an increase of oxygen which facilitates the transformation of ani-

mal and vegetable products into harmless chemicals. Nevertheless, this purification is seldom if ever complete and is not to be trusted.

Lakes are purer than streams, as a general rule, since their waters are quieter and suspended matter settles more quickly. For the same reason, pollution rarely extends more than half a mile from the shores. The very deep water layers are remarkably pure, inasmuch as practically all the injurious elements have been filtered out or destroyed during the percolation of the surface supply down into the depths of the subsoil. Snow is less pure than rain. It not only readily takes up impurities encountered in its fall, but continually absorbs more during the time it remains upon the ground. Ice is sometimes thought to be safe for no better reason than that it is frozen. As a matter of fact, many virulent germs including the typhoid fever organism will survive long periods of freezing. As they are most abundant in the vicinity of air holes, bubbly or snow-ice is especially unreliable.

To Find Water.—Water is most likely to be found, or easily reached by digging, where the grass is greenest. A cloud of insects is a good guide, even in level country or desert land, especially if they hover over a depression. Among hills, a shaft should be

sunk in the lowest places; not on a spur, but in valleys, especially at the junction of one with another, on the side nearest the highest slope. It must be remembered, however, that the nearness of the ground water to the surface in such a location renders it objectionable as a camp site.

Qualities of Good Water.—Good water should be tasteless, odorless, clear and well aerated so that it sparkles, colorless, except for a faint blue tint when it is viewed in depth, as in a tall, glass vessel, and free from injurious chemicals and parasites. A very small amount of mineral salts increases its value for drinking purposes, but a larger quantity is likely to cause stomach and bowel complaints. The only final proof of excellence, however, is a series of satisfactory laboratory tests. A specimen may be beautifully transparent, and teem with disease producers. On the other hand, silty, turbid waters are often very pure after they have settled. Other samples may be badly discolored without being unfit on that account; such as brown, peaty waters, which were highly prized by sailors in times past because of their good keeping properties. Or the supply may have derived a more or less unpleasant flavor, from iron, for example, or be salty if it is taken from wells near the sea, and still be

suitable for human use in spite of these attributes. A very cold, clear spring is probably fed from deep sources, and is generally above criticism. Nevertheless, not even this should be accepted without suspicion, unless it has been officially pronounced safe to drink; while the rule to consider all surface water dangerous until it has been sterilized must be inflexibly maintained.

Wells.—Wells may be shallow or deep. The first collect their contents from superficial sources and are simply reservoirs of drainage. Everyone knows that pollution is almost sure to occur if there is a stable or privy located upon adjacent higher ground; but many overlook the fact that a similar institution on a lower level may be even a greater menace. A buried ridge of rock may present a perfect barrier to the seepage from above, while that below may percolate directly into the general layer that supplies the well. This drains a circular area the radius of which equals four times the depth of the shaft, and anything foul within the circumference should be considered a source of contamination whether the slope be up or down. Nevertheless, shallow wells may yield a perfectly pure supply in localities that are free from human and animal defilement; but it is not usual for troops to operate

in such regions, and when they do, they themselves may be at fault. The deeper the pit the better the water, owing partly to the fact that this has been thoroughly filtered; so that at a depth of fifty feet one may expect to find practical perfection almost anywhere. Yet even in this case foul drainings may enter from above, flow down the sides and spoil the clean, wholesome collection at the bottom.

To obtain pure water at all times from a well, this should be sunk through all layers down to impenetrable clay or bed rock. The whole interior, except the bottom and as much of the walls as lie in the deep, water-bearing strata should be lined entirely with stone and concrete so as to be absolutely waterproof. If the upper soil is especially contaminated the further precaution may be taken of packing the outside of the lining with a thick coating of clay, which is permeable neither to water nor to germs. The top may be finished as a dome provided with a manhole, rendered impervious like the rest, and the structure buried, only the pipe from the pump communicating with the outside. Or the construction can be carried up above the ground, which should be banked and sloped around it, and then closed. All open wells, including those that are improvised for temporary use, should be pro-

tected at the top against the entrance of rain washings and other surface drainage, either by mounds of earth or by some other protecting rim. They should also be tightly covered to exclude mosquitoes and to prevent small animals from falling into them, as well as to preserve them in a state of cleanliness. The darkness of a closed well hinders the growth of algae and of other undesirable vegetation. Pumps should be placed to one side, clear of the main structure and not on top of it as is so often done, to prevent drippings and excess from flowing back into the supply or from washing impurities into it.

A driven or tubular well requires a pipe fitted at one end with perforations and a strong, steel point. This is driven into the ground and additional plain pipe screwed on as needed. It penetrates at the rate of eight or ten feet an hour, but is blocked by moderately hard stone and clogged by sand. Theoretically, and usually in practice also, it will deliver pure water, taken only from deep layers, with a constancy and abundance dependent upon the nature of the stratum reached. Seepage from above may flow down the outside of the tube, but this is unlikely. Twenty-five feet is the greatest practicable depth if a suction pump is used. Artesian wells are constructed by boring, some-

times to an almost incredible distance, until a bed of water is tapped between two impermeable layers, of sandstone for example. They are not possible to ordinary field engineering.

Cisterns and Tanks.—Rain is sometimes collected in cisterns or tanks for drinking purposes; but the first part of the fall should be rejected, since it is soiled with roof scourings and wind blown waste. Therefore, reservoirs are usually equipped with some sort of automatic device for the purpose, or a by-pass is included in the downspout and operated by hand. The latter method is unreliable and objectionable for many reasons. A quart of rain is sufficient to effect ordinary cleanliness over two square yards of collecting surface. Area, multiplied by one-half the rainfall in inches, gives the total yield of water, approximately, in gallons. The quantity admitted to storage should be filtered, and the same care should be taken to exclude light and insects and to prevent contamination from entering cisterns and tanks as with wells. For sanitary reasons it is better to build them above the ground rather than below it. If iron tanks are used, their interiors should be coated with cement or with asphaltum unless they are galvanized. Wells, cisterns and all other reservoirs should be inspected frequently and cleaned as required.

Purification by Boiling.—Most water has to be sterilized, that is, so treated that parasites are either killed or removed, before troops can safely drink it. In many instances it must be clarified as well. The readiest and most efficient way to accomplish the first is continuous boiling for not less than twenty minutes. Much of the suspended matter will settle out during the subsequent cooling. But the method yields a characteristically insipid and unsatisfying product, owing to the fact that all air has been expelled from it; and it may, besides, have absorbed creosote and other unsavory vapors if an open wood fire was employed. Nevertheless, though a large can and a bonfire should be the only available facilities, the certainty of securing by these simple means a supply that will not transmit disease would offset such comparatively trivial objections. A more serious drawback is the time consumed. It is almost too much to expect men to wait patiently at the end of a dry march for water to be boiled and cooled, and they will not accept it hot. Pouring it from one vessel to another shortens the period of waiting and aerates the water as it cools, so that it becomes more agreeable to the taste; but the increased handling augments the possibility of contaminating it anew, and so it is preferable to convert it into tea, which is not

only refreshing and enjoyable but assuages thirst better. The tannin, moreover, steeped out of the herb, assists in the clearing process. Yet the beverage should not be "strong."

Sedimentation. Mineral Jelly.—Sedimentation may precede, follow or accompany other treatment. It consists in causing suspended fine particles of organic or mineral matter to fall to the bottom, either by letting the water stand in covered containers or by adding certain chemicals that greatly accelerate precipitation. Thus, six grains of potash alum to the gallon, with one third as much carbonate of soda, will produce an opalescent cloud of "mineral jelly" which entangles in it most of the offending substances and carries them quickly down. No alum remains in solution, for it is entirely broken up in producing the gelatinous material. As for the soda, though it is harmless, none may be needed if the water contains a considerable amount of mineral salts, that is, does not lather easily with soap, since these enter into the combination to some extent and are thereby happily eliminated also. It is not necessary to measure the chemicals exactly; a slight excess is not injurious and is perceptible to the sense of taste. Iron, tannin and the juice of cactus leaves are sometimes used, but alum

is the best as well as the most convenient clarifier. Sedimentation purifies and sterilizes, therefore, by precipitating obnoxious matter, even invisible organisms; but incompletely. It is useful and sometimes essential as a preparation for more thorough measures, such as filtration.

Filtration.—After the supply has been settled or otherwise clarified, if necessary, purification may be completed by means of a proper filter. The most efficient of these is the Chamberland-Pasteur, in which water under pressure is forced through a cylinder of unglazed porcelain. The product is absolutely pure, at first; but the germs, which are not killed, simply held back mechanically, multiply in the pores of the clay until they grow through, so that finally the output is worse polluted than the intake. It is necessary, therefore, to boil or to burn out the candles every few days. Apparatus of this kind has been used in the field, but the essential part is so fragile and so much care is required that the method has proven impracticable for troops.

The ordinary household contrivances intended to be screwed to faucets, and packed with cotton, charcoal, quartz and various other materials, are simply money getters. They may clarify, but they never sterilize.

On the contrary, their filthy contents usually breed and give out more germs than they receive, and the sense of security these arrangements impart is, consequently, entirely a false one. Bacteria will even penetrate fifteen feet of sand. However, fifteen inches of this will exclude them if the top be fortified with a layer of vegetable or mineral jelly. On this principle great filter beds have been constructed which deliver millions of gallons of pure water daily to cities, and ingenious applications of it have been made in the field, also, very successfully.

Improvised Filters.—One type of improvised filter is made by putting into a large barrel a few inches of coarse, well washed gravel, on which is adjusted a smaller cask with perforated bottom. The space between, which should be as wide as choice of materials permits, is then packed with clean, sharp sand to a depth of not less than fifteen inches and as much more than that as is practicable. Water in the outer compartment percolates down into the gravel and rises to a corresponding level in the inner chamber whence it may be drawn off by siphon or pump. Mineral jelly is mixed with the first part of the supply to form a protective coating upon the sand. As it is very light, water should be flooded, rather than poured, in, so

as not to agitate the particles and thus denude the filter surface. The action of the appliance is likely to be rapid for a short time, and the product turbid with scourings; therefore the first portion should be rejected.

After a more or less considerable period, depending upon the proportion of impurities in the water, the upper layers of the refining material become clogged and caked, and delivery sluggish. Thorough cleaning and renewal are then required. The arrangement may be set in a stream which is afforded entrance through holes bored in the outer container at a convenient distance above the sand. It is obvious that the top of the inner cask must be higher than the surrounding level. By this plan no feed pipe or hauling is needed, the intake is admitted so gently that the jelly layer is always undisturbed and the process, consequently, not vitiated by careless manipulation. A river bed in sandy soil, lined with slime from decomposed vegetable matter, the so-called vegetable jelly, constitutes a natural filter. A well dug several feet from the bank will yield excellent water in the absence of contamination from the land side. A miscellany of modifications of the sand and gelatinous alumina device will readily suggest themselves, such as a pipe or other conduit

so fortified, leading from a higher to a lower level, or from a stream into a cistern. But all filters of whatever kind or principle must be constantly and carefully watched and cleaned, their products checked by laboratory tests whenever possible, and attended by details who are perfectly reliable and properly instructed; otherwise the command may be poisoned by a supply worse than the initial source.

Field Appliances.—In the effort to solve the problem of pure water for large bodies of troops, a great many inventions have been tried, some designed for transport on wagons and others mounted on wheels. There are boilers and filters of ingenious and more or less complicated design, useful and efficient, for the most part; but in spite of all attempts the question is not yet fully answered. Appliances so far proposed are open to one or all of many objections. They require good roads, and animals or engines to propel them. They add to the already lengthy trains. They are cumbersome and unwieldy. They consume fuel which is sometimes a very scarce article. They get out of order and are difficult to repair. They are not available for small organizations, and they are frequently not at hand when most needed.

Sterilizing by Chemicals.—During recent years attention has been more and more directed to sterilization by chemicals until now this method is fast supplanting all others. It has the advantages of being easy, certain, harmless, and increases the impedimenta so little that it can be disregarded in calculating transport, as far as any special apparatus is concerned. The most satisfactory agent is the ordinary chlorinated lime, commonly known as bleaching powder. The proportion used is one part of chlorine to a million of water, representing about one pound of the compound to 33,000 gallons. As commercial samples vary in the amount of chlorine they contain it is advisable to use a stock that has been standardized. Germs will not survive in even so dilute a solution more than half an hour, and the ratio may be doubled without rendering the water offensive or imparting a flavor to it.

A sterilizing bag with a capacity of several gallons s now issued to troops, made of canvas attached in ıe form of an inverted cone to a metal ring. A few ches above the point at the bottom is a row of lf-closing spigots. The weight, empty, is five and e-half pounds and it can be carried as readily as a nket. The chemical is of known strength and is

supplied in glass tubes so small that a hundred can be comfortably carried in a coat pocket. The bag is hung from any convenient object and filled with water obtained according to circumstances. The contents of a tube are then added. In a short time suspended matter has settled into the inverted apex, below the faucets, and the water is ready to use. This is unquestionably the nearest approach yet made to a practical solution of difficulties connected with the drinking supply, and future developments will undoubtedly follow the same principles; which are, simplicity, availability, certainty and rapidity of operation under all field conditions, independence of special mechanism and the necessity for an infinitely minute quantity of a cheap chemical procurable anywhere. When it is required to convey water on the march, the admixture of a suitable amount of the chlorine powder in the tanks obviates the need of any further refinement at the terminus; so that the water wagons suffice both for carriage and for sterilizing. This plan is finding considerable favor and has everything to recommend it.

Care of Drinking Water.—The water source, whether it be purified or not, should be protected at all times against defilement. The allotment prepared for human use should be stored in insect and dust proof

receptacles, and a guard placed over it to see that it is kept wholesome and that there is no waste. Water cans should be plainly labeled and fitted with faucets. If such are not procurable and a dipper is necessary, care should be exercised that no one drinks from it or puts his hands into the general supply. The best way is to charge an instructed sentry with the duty of baling it himself. Under no circumstances should there be a common drinking cup. It is a reprehensible, dangerous and inexcusable provision. Some, too indolent to procure their own, will drink directly from the spigot. This, also, is a vicious practice and must be prevented. When reason and teaching do not avail to make men careful, infractions of water discipline must be severely penalized.

CHAPTER VIII.

FOOD.

Food Values.—The conversion of food into body energy and tissue is accomplished by processes of oxidation; that is, in the same way that a stick of wood liberates power in the form of heat and is changed into different matter when it is burned. For this reason values are properly expressed in terms of heat regarded as force. The unit of this is the calorie, which is the amount of heat needed to raise a gram of water one degree Centigrade. For greater ease in making calculations, 1000 times this is called a great Calorie, spelled always with a capital. The English equivalent would be about one pound four degrees Fahrenheit. A man needs sufficient nourishment to yield from 2,400 to 4,000 of these daily, seldom more, according to whether he is simply vegetating or striving to the limit of his ability. As a Calorie represents a little more than a foot ton and a half of work, it will be observed that in twenty-four hours the body performs enough labor under average circumstances to lift a 3,000 ton steamer a foot or more out of a dry dock. The point demonstrated is that a soldier must have abundant

food. There is no economy in short rations. It is cheaper to sustain him in full vigor on the firing line than it is to build him up out of a debilitated condition.

Proximate Principles.—In addition to water and mineral salts, food is composed of three principles: proteids, typified by flesh and eggs; carbohydrates, which are the sugars and the starches; and fats, including oils. Meats characteristically construct and repair tissue; carbohydrates do so also, to some extent, but are more concerned in evolving energy; fats and oils primarily produce heat. An excess of any kind of food is stored in the body as sugar and fat. Almost every article of diet contains all three components, though one predominates and serves to classify it. Beef, for example, is one-sixth proteid; the balance is chiefly water, with a little sugar, mineral and fat. Potato is largely starch, with a small quantity of proteid and considerable water; butter is nearly all fat, but includes a negligible amount of proteid and sugar. It is said that a ration so blended as to satisfy the wants of a man doing moderate work ought to comprise the proximate elements in the respective ratios of one, four, and one-half. Thus, a quarter pound of proteid, a pound of carbohydrate and two ounces of fat would give a little over 3,000 Calories.

But it is clear that in order to plan a dietary with such accurate precision as to be scientific, one must know the percentage composition of all ingredients by weight, and have at hand a laboratory to determine the deficiencies of the individual and to check the results. This is absurdly impracticable and wholly unnecessary in messing troops.

Feeding Troops.—The common sense application of fundamentals is enough. As for quantity, men are usually overfed. In barracks, for instance, if they are given an opportunity they will eat to repletion, sleep two or three hours in the afternoon and grumble about their supper when, as a rule, the trouble is not with the food, but is due to their own state of surfeit, with no hard labor to justify it or exhausted tissue to draw upon it. Their systems reject the idea of more and they vent their instinctive aversion to it upon the cook, in ignorance of the true condition. In the field, the same generous meal would elicit only praise, because it would be consumed with relish in response to the demands of their depleted and tired bodies. Naturally, a man who is wearing out his muscles and nerves finds fault with a preeminently starchy diet. He wants meat in addition and plenty of it, though he may not know why.

Men at rest are generally given too much proteid. Their ration should be varied, but reduced to a mere sufficiency, not composed of bacon or beef three times a day with only a dab of vegetables as it is so often. Excessive meat eating is a habit with our men and they complain if they do not have it at every table; but it is unnecessary, expensive and injurious, in superabundance. Cravings sometimes, though not always, indicate the element that is lacking. On the march, for example, men may be seen to nibble on bits of sweet chocolate or candy, especially if they are very tired. Obviously they are drawing upon their reserve supply of energy producing substances and are turning to the carbohydrates by instinct, for more. Increase the starches and sugars before the march, to furnish power, and the meat and albumens at the end to repair their worn machinery.

To a certain extent fats will replace carbohydrates. This may be one reason why soldiers, in the absence of cereals and sweets from the usual field breakfast, prefer bacon to beef. But the distinguishing attribute of fat, heat production, is best evidenced in the Arctics where men who could never before tolerate it crave and demand it. It is well to provide an abundance of plain, hard candy for moving troops, to be carried

in the pockets or packs. To a jaded man it is far more than all the alcohol he could get. At time the command has relapsed into dead si and their eyes show dully in dark socket round of candy will often set them to chattering a brighten their features and stiffen their backs. Sw lessen the desire or tendency to use alcohol, whic in some respects, a substitute for them or at lea likely to be used as one. This class of food prod stomach and bowel disorders when eaten in ex So, also, do fats. Men can endure an exclusive r diet a long time and work hard, but vegetable a or fruit juices should be taken to prevent scurvy. will probably not occur, however, if the meat be alv fresh.

Kitchen Cleanliness.—The cook should be only well qualified to perform his duties, skilled in art of economizing the ration, in utilizing left stock and in devising pleasing variety, but he sh be a model of cleanliness. The health of an en command may rest in his hands. If he is a ca of disease, whether this be some venereal affec dysentery, tuberculosis or typhoid, he may wreak r havoc than the enemy. His aprons and kitchen l should always be clean, his hands and especially

nails above reproach, particularly after using the toilet, and he should have a towel for himself instead of mopping upon rags and dish cloths. Even in the field, when considerable laxity is necessary, there should be no relaxation of the principles of these requirements.

The assistants should be as creditable as he; and the kitchen police, too often detailed in punishment from among the refractory, should be, on the contrary, selected carefully for their intelligence and the faultlessness of their personal habits. Indeed, the kitchen and its occupants ought to be objects of pride to all concerned. In the regular establishment, at least, this is the case. Nothing so pleases an old cook as to have his company commander invite guests into the kitchen and to hear their plaudits upon the spotlessness of the tables and the pans, the polish of the knives, the whiteness of the floor, the neatness of the shelving, the orderly arrangement of scalded cloths and utensils and the excellence of the cooking. Encouragement of this sort is admirable discipline. In addition to these, painstaking attention to the wholesomeness of refrigerators or ice chests, the screening or boxing of supplies and the prompt removal of litter will be reflected in an organization that is well nourished, little troubled

with digestive disturbances, and close upon the heels of their leader in the field.

Meats.—Beef that conforms to the standard is the flesh of a three to five-year old steer; the dressed carcass of which weighs about sixty per cent. of the live, is one-fifth bone and shrinks twenty-five per cent. in cooking. If beef is furnished on the hoof it should be slaughtered from twenty-four to thirty-six hours before issue, in temperate and cold climates, and from eight to ten hours in hot seasons. Good meat presents a marbled appearance and is firm and elastic to the touch. The color of the fat is a light straw, that of the flesh should be red, but varies according to the age of the animal and the circumstances of its death. If it was very young it is pale and moist. None that is livid should be accepted; for a dark purple indicates that the creature was not properly slaughtered and bled, but probably died from some illness. Soft spots, a sticky or yellow opaque fluid, or a bad odor imparted to a knife, signify disease or commencing decomposition. Frozen meat is less nourishing and shrinks about ten per cent. more than that recently killed. Mutton is very like beef. Pork is distinguished by a large fat content, of which fish has practically none. To avoid tapeworm, trichinae and a few other infections, all

meat should be well cooked. Cattle should never be driven hard or for long distances before slaughter, as the flesh becomes tough and contains undesirable substances produced during fatigue. Some kinds of fish are poisonous even when fresh, and unknown varieties are better left untried.

Cooking Meats.—Broiling and, strictly speaking, roasting, consist in exposing meat to an open fire. Baking implies cooking in an oven. In any case, the temperature can not be too high at first, in order quickly to sear the surface and confine the juices. It should then be lowered to 170 degrees Fahrenheit and continued about twenty minutes for every pound. Frying is cooking in melted fat as hot as it is possible to get it, and deep enough to permit complete immersion. Otherwise, the meat will be impregnated with grease, indigestible and distressing. In boiling, the joint or cut is plunged into water that is bubbling hot, to coagulate the outer layers. The heat is then reduced and maintained as in baking. Little or none of the nutritive elements should exude into the water. In stewing, the meat is divided into small pieces and then immersed in cold water which is then slowly brought to and kept at 170 degrees, for several hours. Soup is made in much the same way, but the heating is done very

gradually and at a low temperature, as much of the nourishment as possibl The method is exactly opposed to bo a fluid food, mixed with grains and ve in it, if desired, which stimulates diges diment, invigorates and satisfies. A di at the immediate close of a march is a most restorative, as European armies well know. troops, however, do not take kindly to it, unfortu and one reason may be that the great tendency of is to apply too much heat to everything they pr Soup can not be savory or possess any appre food value if it is simply water in which meat ha boiled. Good soup solidifies into a jelly when cold, and a supply of this, as stock, derived scraps, bones and left-overs that are altogether too erally wasted, should be always on hand if only matter of economy. Hash is another dish devis redeem food fragments, but it should never be pared the day before it is to be eaten, since it causes ptomain poisoning under such conditions.

Vegetables.—Although peas, beans and le contain considerable proteid, vegetables as a cla carbohydrate foods. Potatoes, corn and other g prepared as mush, cake or bread, for example

chiefly starch. Beets are rich in sugar. Cabbage, radishes, tomatoes, cucumbers, onions, spinach, carrots, turnips, greens and fruits in general, have little food of any kind in them, but help to flavor insipid dishes, to introduce bulk and variety and to furnish acids and mineral salts, which are very necessary. The woody fibre, of which plants are principally composed, is a variety of carbohydrate which can be digested by animals, but not by man. Insufficiently cooked vegetables are very indigestible and irritating. Nuts contain proteid, fats as oils, and carbohydrates, with relatively little water. They are highly nutritious, but not very easily digested and should be eaten sparingly. Certain staple vegetables, notably potatoes and onions, are sometimes dessicated, that is, freed from the large amount of water they contain, and are thus rendered compact and very convenient for field use. They have the additional advantage of resisting decay a long time in this state, but they must be subjected to prolonged soaking, sometimes twenty-four hours or more, before they can be softened enough to prepare them for the table.

Canned Food.—Troops must rely to a great extent upon canned supplies. Although food properly sterilized may keep indefinitely in air tight vessels, some

of it will invariably ferment and
particularly if it has been prese
Rough handling with resulting
of seams, or minute holes in the
means by which decay is admitted.
show only two solder-holes at most.
or if an occasional tin exhibits two
in the same case have only one, inferiority
tents is indicated. The explanation is that
tainers differing in this respect from the other
to ferment in storage, were punctured to let
out, heated again and resealed. The ends
concave and not emit a hollow sound when
Bulging, even if slight, is proof of decomposition.
interior of the can is usually discolored by a dark
This is of no consequence. Actual blackening
ever, is caused by putrefying meat, or is due
cessive heating necessitated by stock that was
together fresh and hence difficult to sterilize.
should not be opened until they are needed, and
food should be permitted to stand in them.
should be emptied at once and then thoroughly
out in the kitchen fire or incinerator.

Flour and Meal.—Good flour should be
in color, not yellow; free from
iness, dampness

dor. If the sample does not fulfil these con-
it is spoiling and will not make good bread.
:lean winter wheat yields the best keeping prod-
all grades deteriorate with age. Weevils, which
ll beetles, and mites are found only in poor
ıs, especially those which are damp. Occasion-
may be encountered in good flour, but this
ıould be regarded with suspicion. These in-
ıse further impairment by devouring much of
itive elements, and are hard to eradicate. Sul-
s kills them but also damages the flour. If
)ly is in bags it will absorb odors, and conse-
must not be stored near vegetables or aromatic
:es. It is best stacked in a dry room, in such
ɜ to permit the air free circulation in all parts
.ers. Tight barrels or well sealed metal boxes
h preferable to sacks.

meals and grains are also sometimes infested
;s and larvae, and should be packed and handled
: same care as that bestowed upon flour. The
; found in hard bread are hatched from eggs
d during the drying process, by moths. All
:uffs should be carefully covered with muslin
:cted by fine screens. Loaves should be laid
sides or ends. Acid bread is caused by poor

flour or old yeast. The difficulty may be remedied in the first instance by mixing the dough with water in which quick lime has just been slaked. This is much better than soda. Cutting the loaf into thin slices and serving it as toast may render it acceptable. Bread made from leaven, which is simply a little dough remaining from a previous mixing, must be consumed immediately as it does not keep well and becomes bitter. If it is necessary to renew the yeast and none is procurable, a ferment of about half the strength may be made by setting a small quantity of thin batter in a warm place until bubbles form. Much better results may usually be obtained by adding a little piece of an overripe but not rotted banana, which generally contains active yeast.

Improvised Kitchens.—The field ranges and portable ovens furnished the army are so readily carried on almost any sort of conveyance that substitutes for them will seldom have to be improvised. Traveling kitchens and field bakeries are also provided, so that even on the march the command may be well served with hot meals. Yet there are times when troops must adopt expedients. The simplest is a trench with a sheet iron cover, at one end of which is the fire and *at the other an opening* or pipe for a flue. If clay

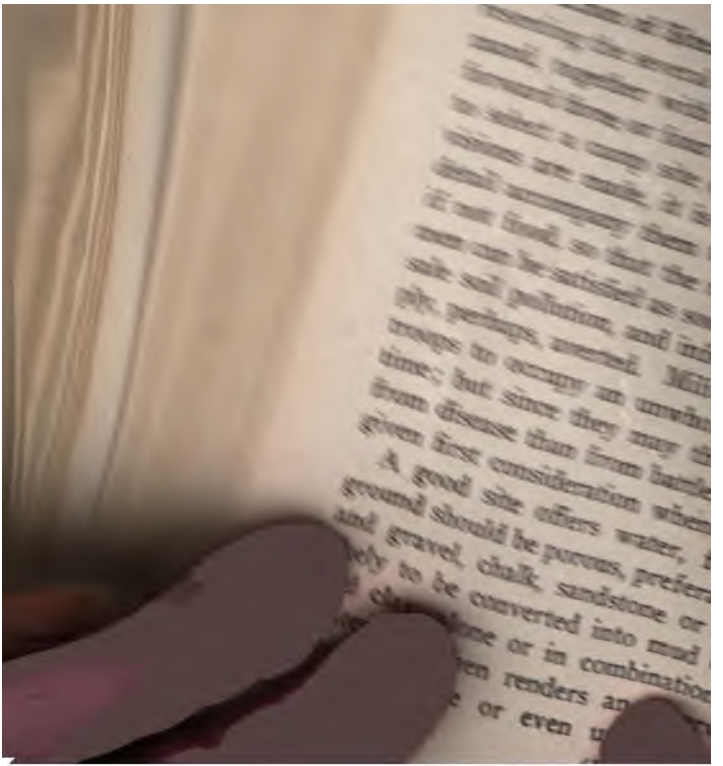
is obtainable this may be thickly puddled over two barrels laid end to end on their sides with the bottoms knocked out. The top of this mound is smoothed flat and provided with holes in which to set pots or to facilitate the heating of pans. One of the terminal openings may be banked with earth or otherwise closed, and fitted with a vent for smoke.

In connection with a covered trench or a stove of clay, mud and rock, bricks or similar material, ovens can be made by including oil cans in the structure. A series of these set side to side upon the top, the whole row embedded in clay or otherwise insulated to retain the heat, and exposed to the fire below, furnish means for baking, or for keeping meals hot. Flat ɔieces of tin hinged with wire provide doors for the ıvens and may be banked with ashes or earth for urther protection against inequalities of temperature. arge metal buckets fitted with lids, thrust vertically to openings over the fire and surrounded with well ıddled clay, answer the same purpose. A thick layer grease and water in the bottom will splutter as soon it is hot and in doing so automatically bastes the at. A more primitive but a time honored device is ɔle of a convenient size dug horizontally into a clay k. *Another of* small diameter communicating with

this perpendicularly from above serves for a chimney. It is used, like a Dutch oven, by heating the interior thoroughly with a brisk fire, sweeping out the embers and then putting in the food to be cooked. During this stage the openings must be well closed. Another classic resource is a hole in the ground with bricks or a large flat stone on the bottom. The pit is heated, the food, in dirt proof containers, then lowered into it, and the cavity sealed by pieces of board and a mound of earth.

Fireless Cooker.—A fireless cooker may be improvised by enclosing a metal container in any suitable box, and filling the interspace, which should be not less than two inches on all sides and the bottom, with chopped hay or with sawdust. A cover for the inner compartment and a double lid, between the two layers of which is a similar packing, complete the arrangement. Food heated to the desired degree and then placed inside will continue to cook for several hours afterward, and will even be hot enough to serve at the end of twenty-four hours. The greater tenderness and the better flavor of foods prepared in this manner demonstrate the merit of cooking at a low heat; and the fact that the men are enabled to have hot soup or a meal at instant notice makes this simple accessory

exceedingly valuable to marching troops. In hot weather it can be used for the opposite purpose, that is, to keep food and water cool during transport. Another excellent improvisation is pans and baking dishes made of greased paper. These must, of course, not be used in direct contact with the fire.



n summer, a level stretch upon high ground,
reezes and shaded by a light growth of
t to be sought. In winter, lower ground
ere woods or nearby hills will break the
s. Woods, indeed, are excellent, for both
anitary reasons. Yet they must not be
stand on sodden, boggy land. They
, protect it alike from winds and the
sun and modify extremes of tempera-
e grassy spots, since there are neither
n of light to distress the command.
n should be kept short and heavy
ved entirely.

good roads leading to the place,
t ought not to be so situated that
amps must pass through it, nor
gh these to its own units. Old
d if they were occupied less than
fore. The ground water should
or twelve feet, six or eight if
. Therefore, locations at the
ys, particularly at the junction
jectionable; for on wet days
d and once wet remain soggy,
ing long afterward. Th-

vicinity of swamps, marshes and stagnant pools is objectionable. If it is necessary to encamp near them, they should be distant not less than three hundred yards, with woods intervening, if possible, to intercept mosquitoes.

To summarize, a camp site should be healthful, should be kept free from infection during the period it is occupied, and should be left at least as safe for others as it was found, when it is abandoned. Finally, it is better that the men, even though tired, should march a mile or two additional if there is known to be a more salubrious site farther on, provided military conditions permit; for though only a bivouac may have been contemplated, a stop of one night is often prolonged into a stay of many days, in war.

Varieties of Encampments.—Camps may be temporary, semi-permanent or permanent, depending upon the purpose for which they are established and the time it is planned to occupy them. But the sanitary principles of all differ only in application according to the means available. A mere bivouac will be provided with few facilities. A permanent occupation or a formal cantonment will be carefully designed, material sent on in advance, possibly barracks and storehouses erected and sanitary machinery installed.

es and ... type may be prescribed, however,
...sary to ...rate a large command into several s
...t less ... is to organize one big one, and t
...ing, if ... as practicable in any single shelte
...imize the incidence and the spread of
site ..., which are accidents especially favo
infection ...ions.

be left a... ...ts.—Tents, which are the shelters u
n it is a... are likely to be hot in summer a
even ... since the porous nature of canvas an
ional if ... direct communication existing betwe
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h only a ... Consequently they are very responsiv
of one ni... ...es in the atmosphere, and tent life is
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ts.—Camps ...e much warmer than the average out
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...re estab... ...e case, and the walls are raised, an up
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...applica... ...able. In rainy weather and in cold,
...bi vouac ...er is made as tight as possible so as to b
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...barrack... ...able interchange occurs through the
...hinen... ...ides. These, however, become closed

fabric is wet, and openings must be provided
cially in the top. A fly, supported several inche
the tent itself and projecting beyond it on all si
at both ends, obviates most of the discomfo
difficulties due to temperature and humidity.
it is a necessity. Ventilators in the attic becor
sible; the interior is cooler in summer and wa
winter; and rain and snow do not clog the p
the walls nor leak through. If tents are floo
they properly should be, the boards must be lc
high enough above the ground to permit inspecti
cleaning, as the amount of rubbish that can n
ously accumulate beneath them is astonishing.
vent flooding, ditches should be dug on all sid
as wet canvas shrinks in drying, tent pins o
be driven so as to slope toward the tent and nc
it, in order that they may pull out of the ea
thus save the tightening walls from splitting.
a rain, especially if there is no fly, objects tc
the inside of the walls will cause water to seep t
Every two or three weeks tents ought to be
far enough to expose the ground they occupie
to the sun. After another similar period they
restored to their original position or again se
a new place. Unless this course is followed th

will eventually become so foul as to constitute a menace. In addition, it is well to roll up the sides or to drape the tents, as often as the weather permits, so as to air and sun not only the ground but the bedding and the clothing also. To make tents more comfortable in winter they may be lined with blankets or paper. Small stoves fitted with flues that pass through metal guards in the canvas assist ventilation in addition to furnishing heat; but oil burners and similar unvented fires, especially charcoal braziers, are dangerous.

Miscellaneous Shelters.—Log cabins, huts of mud and sod or of clay and wattle, roofed with tentage, dug outs and other underground shelters are useful at times, especially in severely cold climates. But over-crowding, and the construction of bunks in tiers, are to be positively forbidden. Tents may advantageously be connected as wings to these structures, improve ventilation, and are themselves rendered more habitable in winter because of the better heating facilities thus made possible. All dwellings constructed below ground, however, are open to grave objections familiar to those who have observed the mold, the dampness and the bad atmosphere of cellars.

Military conditions may compel such expedients, in spite of the toll of disability that will be exacted, but

they should be a last resort. Fortunately, men become inured to these things, and those who survive pneumonia, bronchial disorders, rheumatism, tuberculosis and the other maladies incident to exposure will eventually become seasoned, and immune to conditions they would have thought impossible when they were civilians. Not infrequently, particularly in trench warfare, sufficient air space, adequate ventilation, sunlight and dryness in quarters become simply ideals practically impossible to attain. Nevertheless, they should be approached as closely as military necessity and the means at hand allow; for good sanitation is also a military necessity since every man kept off the non-effective list is equivalent to a rifle gained. If troops are billeted, the situation may be either simplified or complicated. The only toilet arrangements, for example, may be an unvented, untrapped metal funnel opening directly into a cess pit beneath the house. Tactful cooperation with the civil authorities, if there are any, and kindly assistance to the householders, whose rights must be respected, may be all that is necessary to effect improvement.

Camp Sanitation.—The detail charged with the duty of preparing the camp should endeavor to pro*vide spaces between* tents equal at least to the width

of one if not two. Spreading the troops to avoid infection is not accomplished by crowding the shelters of units and leaving extensive parades between regiments. The latrines should be located where they will not contaminate the water supply, and on the side opposite the kitchens. If a stream furnishes the water, sites for obtaining that used in drinking and cooking, for watering animals, for bathing, and for washing clothing, should be chosen from up-current downward in the order named, and plainly marked. As soon as the command arrives, guards should be posted over these and at the sinks; for there will always be some who will defecate on the river bank, on the outskirts of the encampment and even within it. Unless sentries are stationed to enforce sanitary discipline, the grounds will soon be encircled by a ring of feces, no matter what conveniences may have been erected. Some men, too, will merely step outside their tent or go behind it to urinate. This practice is filthy, at best, and should be penalized. To avoid the same thing at night, a can should be placed in each company street, to be emptied and cleaned in the morning. It is well to hang a lighted lantern over it, when possible, to denote its location. Besides, men are much like moths.

Many will be attracted by the illumination who otherwise would get no farther than the doors of their shelters.

When the kitchens are set up, stands to raise the barrels off the ground should be built immediately. Once constructed, the entire camp should be kept immaculate. Though the careless scattering of refuse is to be strictly prohibited, yet there will invariably be more or less, and soon after breakfast every day, fatigue parties are to gather the litter, paper, manure, straw and trash in general. Company streets are better not swept. Whatever detritus and germs have dried into dust will only be blown over the command and its neighbors. Raking and scraping are preferable. Oiling and rolling them, if practicable, will add materially to the common comfort. The tents are to be scrupulously neat, the floors and the earth beneath kept dry and clean. In the kitchens, especial attention must be given dark corners, to see that no soapy rags and food remnants collect to foster insects. The latrines are to be as tidy as the balance of the camp. Wherever ground has been soiled with slops or sullage, it is to be raked or spaded, and fresh earth thrown upon it, if necessary. Camp police, in short, is the practice of *principles already* explained.

To the uninitiated, who see no reason for making a to-do because there happens to be a harmless piece of paper in the road, when they lived a healthy life in a town where there were much worse nuisances, the rigid exactions of experienced officers may seem petty or ridiculous. But unless inconsequential bits are respected, it is only a question of a few days when the picket lines will be neglected also, the kitchens, the latrines and the cleanliness of the men themselves. People living the normal community life, well housed, comfortable, established, and isolated in small groups or families, are not subject to the perils that beset those closely aggregated under mental and physical stress, with no fixed place of abode and existing as best they can upon the ground or in cells beneath.

The physical integrity, and therefore the ability of the latter to fight, are constantly jeopardized by deleterious influences which are increased by indifferent sanitation. It follows that the degree of perfection attained by an organization in police duty is a measure of their efficiency as soldiers.

Since the medical officer is especially concerned with hygiene, knows what is needed, understands the reasons for sanitary procedures and is interested in *devising, studying* and testing methods and appliances, it

is well to make him police officer, with sanitary squads of men from the companies directed by non-commissioned officers of the Medical Department to work under him. The provost sergeant and the fatigue details should report to him for instructions in sanitary matters instead of to the Quartermaster; and he should be responsible only to the Commanding Officer with the authority of the latter to issue necessary orders. He should be allowed considerable discretion, for his functions are specialized and technical, and it may be essential at times to carry the campaign of prevention well beyond the occupied grounds in order to avert physical disaster. This contingency is particularly likely to arise in hot countries, where the men are debilitated and less resistant to disease, decomposition rapid, insect borne infections very prevalent, water almost universally impure and the civilian population in a general state of ignorance and disease. In very cold climates, on the contrary, it is a temptation to neglect sanitation, for the low temperature retards putrefaction so that there is no odor from organic waste and illness is relatively rare. Nevertheless, excreta and other filth left upon or concealed within the snow, which is often the only source of water, will spread contamination there as elsewhere.

Messing.—Some cooks, with a poor fire and few utensils, will often prepare better meals and more economically, than others theoretically superior but less gifted in the art of field cookery. Men should therefore be trained in this branch and opportunity afforded to practice it in garrison. Especial attention should be devoted to vegetables, which are too frequently underdone in the camp kitchen and are then provocative of intestinal derangement. Troops should not be allowed to wander about with their food at meals, but must eat in a designated spot or shelter in the interests of police. The mess sergeant or other authority should be present to see that difficulties are adjusted and that whatever men discard is not cast on the ground for others to clean up, but thrown into the proper receptacles. Boiling water must be furnished for cleaning mess kits.

If individual cooking is necessary, men should be instructed that a half dozen or so small, short sticks kindled into a very tiny fire are sufficient; and this must be carefully guarded, particularly in wooded regions, since it is not unusual for flame to creep beneath dead vegetation and break out at remote distances with serious results. When a camp or bivouac is abandoned, all pits and trenches are to be filled with

earth, foul spots plainly m
oughly policed and the entir
as possible to its original cc
better state.

Cantonments.—The essenti
a camp and a cantonment is that
are sheltered in buildings of som
of sanitation differ in nowise f
to other military communities. B
deliberately selected and the prepa
more elaborate than in camps, so
maintain the command in good cond

The board appointed to choose a l
vote especial attention to the drainag
abundance and the purity of the wate
accessibility of the grounds to railroad
other communications.

The close proximity of a city or a
objectionable to a degree that offsets th
Liquor and women are responsible for
riots and the disabilities that occur under s
stances. Even when an isolated situation
brothels and other dives will spring up a
night around the limits of the cantonment,
be vigorously suppressed. They constitute t
est menace that has to be met.

buildings, in our service, are long, relatively
structures, ventilated, preferably, by the ridge
vre" plan. As in camps, they should be spaced
art over an ample area. There should be a
ent sewerage in preference to camp devices, and
allation of crematories for garbage and other
In short, water and refuse should be man-
s in a municipality.

iously the accommodation of an entire organiza-
nder one roof and in a single large dormitory
ses the liability of the command to the spread
mmunicable diseases. Unremitting watchfulness
requent inspections are therefore indispensable.
erious, infectious disease should be discovered, it
isable to evacuate the barracks and to move the
ed unit into tents. This course minimizes the
er who will be exposed to a subsequent case. The
d of isolation and the management of this sub-
should be determined upon the advice of the sani-
officer.

ansports.—Life on shipboard is attended with
favorable and unfavorable conditions. On the
hand, the sea air is stimulating, [illegible]ely pure,
tempered by the water so that [illegible] likeli-
of sudden changes of ten[illegible]e men

ıer discipline, their food and drink under con—
ıd dissipation impossible. On the other hand,
is restricted, personal contact very close, exer—
difficult, and the humidity so high that clothing
ing and the whole interior of the vessel become
ɔmfortably clammy, sticky or dripping with moist-
e. If to the dampness be added the heat of the
ɔpics, mold completes the devastation of leather and
oven fabrics while the lower decks become all but
ıntenable for men.

It is essential, therefore, that the preparation of ships
for use as transports as well as the disposition of
troops upon them should take into account the ex
tremely favorable circumstances for the spread of dis
ease, the necessity for good ventilation and the ir
practicability of remedying defects after port is le
Therefore commands should not be embarked u
it is reasonably certain that the probability of an
break of infection has been reduced to a minir
To provide for contingencies, ample and suitable
partments should be reserved for isolation. Imm
tion against typhoid, paratyphoid and small-po
be complete and systematic efforts made to
rats from boarding the ship and to extermina
sure to be already aboard, as well as all vermi

Not more than two decks should be occupied as sleeping quarters and the bunks should be allotted not less than twenty square feet of floor space. There should be no more than two berths to a tier with room enough between the lower, which should be about eighteen inches above the deck, and the upper, and between this and the deck above, for the occupants to sit up. There should be a thirty inch passage between tiers.

The air below is contaminated by the breath of the men, gases from the coal, soiled clothing and bedding, perspiration, dust, vapors of oils and greases, tar, paint, bilge water, which is the ship's drainage, vomited matter, toilets, messes and galleys, and storerooms. To offset this state of affairs there must be a system of air chutes and pumps, since the ports are necessarily often closed. The troops should be kept above decks as much as possible, and exercised by calisthenics combined with inspections and rigid police, every day. Bedding and clothing should be aired often, no smoking allowed below, and no baggage permitted on troop and mess decks in order to secure as free circulation of air as is practicable. In hot weather awnings are indispensable. Wind scoops thrust into the ports may drive air in or suck it out according to whether these

present their concavities toward the breeze or away from it. Wind sails, which are large canvas tubes each with a winged opening on one side near the top, which is closed, suspended through a hatch from a point high above the house, are a god-send in hot climates if the openings face the wind when there is one, otherwise the bow. By means of the air they collect and drive down into the hold, ventilation becomes thorough and the decks cool enough to be habitable. Food should be stored in latticed compartments rendered rat proof by wire netting.

The drip from the condensation of moisture may be remedied to some extent by the use of cork paint. The foul contents of bilges and peaks must be removed by pumps which form part of the engine room equipment.

A plentiful supply of receptacles for waste, preferably large metal tubs or rectangular, galvanized iron cans, familiarly called "dog baskets" by the sailors, should be distributed above and below decks, especially on the mess decks. Otherwise every odd nook, particularly the pans of winches and the crevices behind air ducts and steam pipes, will soon become littered with tobacco quids, cigar and cigarette stubs, and bits of food.

Excreta and waste are disposed of very simply by sending them overboard. The water supply, on the basis of five gallons per man per day, should be rigidly examined before the tanks are filled in port, and these should be washed with cement or steamed out frequently when they become emptied. A guard should be posted at every drinking butt, to prevent infractions of water discipline.

Trenches.—Trench life is so monotonous and trying that except under peculiar conditions men are relieved after one to four days. As ordinarily constructed trenches are about seven feet deep and a yard wide, usually fortified above with rows of sand bags, and reinforced by wooden uprights and interlaced twigs, boards or other available material to prevent caving. In the rear wall are shallow recesses which provide more or less protection against rain. Here and there zig-zag passages lead to a similar line behind, where reserves are stationed, and from this other narrow lanes spaced a few hundred yards apart conduct to "refuge spots" whence cooked food and other supplies are sent forward and whither wastes are brought for final disposition. Throughout the system dug-outs are excavated for quarters and latrines. The entire maze is likely to be wet in spite of pumps, and

the men not only suffer from discomfort, but are liable to infection derived from the soil. It is inevitable that they should become smeared with dirt and mud, made worse by perspiration or rain; and with one man to every square yard and no bathing facilities it is apparent that conditions are likely to be all but intolerable. If in such circumstances a soldier is wounded, dirt and filthy clothing contaminate the injury and either lockjaw or a variety of gangrene caused by a germ peculiar to the soil is probable. Hence, besides a liberal supply of iodine with which all wounds should be promptly swabbed out, any measure of cleanliness and prevention, no matter how slight, should be adopted whenever possible; such as flooring the bottoms with logs, sticks or boards, lining the trenches with lattices of any adaptable material and whitewashing the whole. There need be no fear of betrayal to the enemy in devising expedients. Each side knows exactly where the other is.

"Trench Feet."—Another condition, known as "trench foot," is somewhat similar to severe frostbite and may result in the loss of the members affected. It is probably due, in part at least, to a combination of standing in cold water, and interference with circulation by the shrinkage of wet foot wear. Shoes or

waterproof trench boots should be rather loose, lined with fur or felt, and socks should be of the heavy woolen kind that extend well up toward the knees. There should be a plentiful supply of foot gear easily accessible at all times, and opportunity afforded for frequent change. The feet should be thickly greased to prevent maceration in water, and the rest of the body warmly clad but not tightly. Sheepskin and similar hairy linings are particularly desirable in outer garments. The men should keep in active motion as much as practicable. To protect the hands, heavy mittens are better than gloves, and are furnished with a tip for the index finger. Metal, such as eyeglass frames, should be wrapped to avoid direct contact with the skin, as the part touched is likely to be "burned" by any icy film upon such a surface. Hot food and drink are not only cheering but stimulating, and since they have to be carried sometimes a considerable distance through the communicating trenches, containers on the fireless cooker principle are exceedingly useful for the purpose. Plenty of hot beverages on the firing line at all times are much more of a necessity than a luxury. They not only comfort and invigorate, but assure a sterile drinking supply. In all seasons and weathers, when the men are relieved and sent back to

rest, they should be immediately bathed and delou
furnished with good food and fresh clothing, and
verted with exercise and wholesome amusem
Their minds as well as their bodies must be refresh
for there are worse fates and more terrible affliction
than being struck by a bullet. There is nothing to
good for the man who fights the battles of his countr
under modern conditions, nor any effort too great to
make in his behalf.

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HARVEY MILITARY SERIES

First Aid for the Trenches

By

SOMERVILLE HASTINGS
Captain R. A. M. C.

Preface by

Major Frederick S. Macy, M. C., U. S. A.

The greatest little first aid pocket manual ever published. The most necessary book ever printed. Used by British troops on all fronts. Fully illustrated with specially posed photographs.

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